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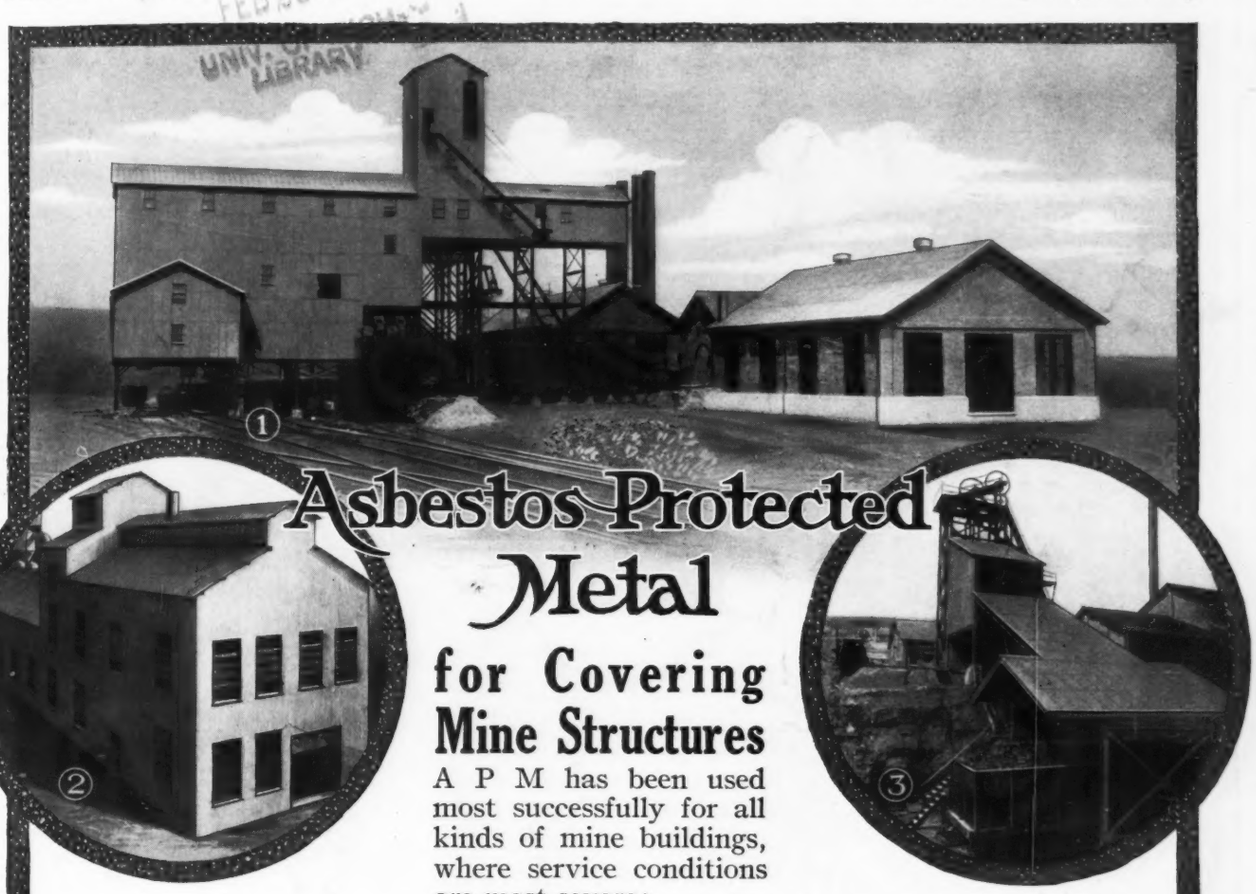

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The S-A Page

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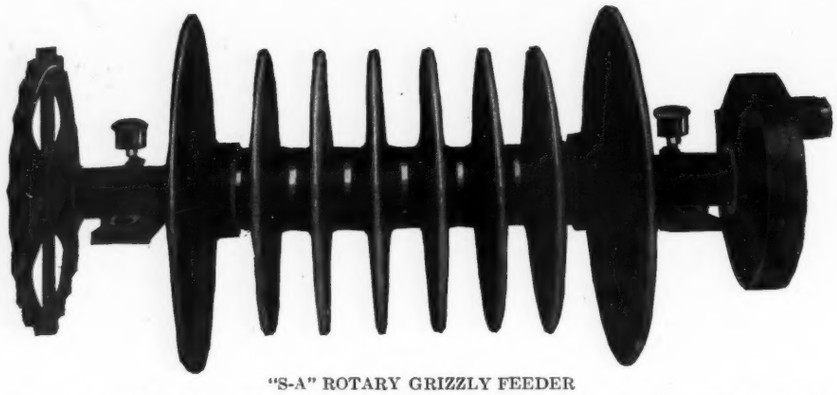

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Mining Journal

VOLUME 101 FEBRUARY 26, 1916 NUMBER 9

The Walhalla District, S. C.

By Frank P. Peterson* and Frank H. Flynn†

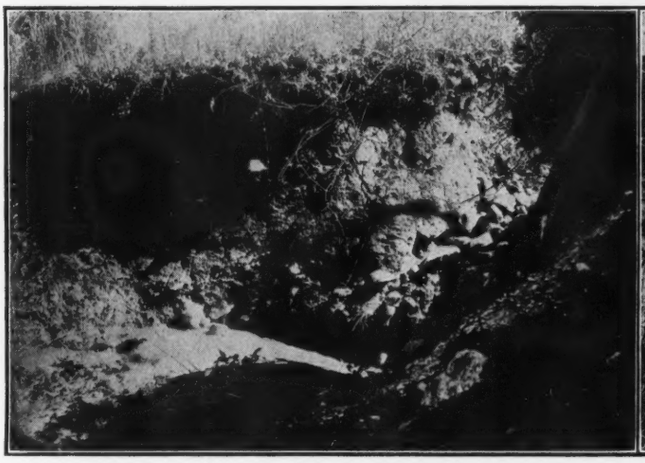
SYNOPSIS—Description of a region in western South Carolina in which all indications point to gold deposits of economic value. Profits were made from free gold in leached surface ores, but combined gold in the deeper sulphides has resisted the efforts of the poorly informed residents. The formation and ores are technically discussed.

It is the intention of the writers of this article to set forth a brief record of the result of some detailed operations, observations and studies of a section of country lying south of the Blue Ridge Mountains in western South Carolina. The purpose has been the seeking of gold in paying quantity, with due regard for the value of any other minerals that might be found, and the work was done in the most deliberate attitude, with no anticipation beyond the pick-and-shovel point and what they revealed from day to day. To say the least, this work, in connection with its geology and mineralogy, has been interesting and instructive.

The historical data relating to the discovery of gold, the efforts to open and develop mining operations in the general area covered, would be too tedious and voluminous, even if available, to present; and considering the fact that much of the history obtainable is indefinite, only such notes as were fairly authenticated will be given. Reference to Government and Mint reports, prior to and shortly preceding the Civil War, will be interesting and are conclusive to the effect that gold earnings were a not unimportant factor for the region. In this connection we might cite a Government report of gold-mining operations at Gold Hill, N. C., for 1854, in which mention is made of the fact that, for want of a means to treat refractory ores, $40,000,000 in ore value was allowed to go into the ditch against a recovery of about $4,000,000.

Some Items of Local History

In the Walhalla region local history has it that one Ernest Cochran, on his farm south of Seneca in Oconee County, opened a promising gold vein. The ores were imperfectly crushed and washed for their free-gold content to the extent of several hundred tons. This operation was self-sustaining until a depth was reached at which the gold was carried in combination with sulphur and the free-gold values were supposedly lost in a vein trend that is now thought to have been normal. It would have probably increased in value had means been understood for its recovery. Sluicing was carried on in this same neighborhood, and gold was obtained from limited placer areas, but no data were available as to the amounts or the profits resulting. Ore piles on the Cochran property showed free gold in leached ore at the surface of the piles and combined gold deeper. James Lovegood took out sufficient gold in the Keowee neighborhood, with slave labor and "Long Toms," for the founding of the Walhalla bank, and Jesse Lay, in the same neighborhood, was successful in mining at a profit with slave labor. Two or three comfortable fortunes were amassed in this limited area along the small tributaries of Little River. These operations were carried on up to the outbreak of the Civil War, which catastrophe put an end to all work of the kind, and practically nothing has been done since then.



CHARACTERISTIC GOLD-BEARING POCKET

GRAVEL BANK OF OLD FIELDS OF SENECA SECTION

*Mining engineer, 535 North Cheyenne Ave., Tulsa, Okla.
†Mining engineer.

It is no new fact that considerable areas of North Carolina, South Carolina and Georgia are gold-bearing. On the Atlantic side of the mountain ranges the gold seems to lie in zones, or streaks, of varying width with intervening barren spaces. These zones vary, as do the intervening stretches, in width. The section of most definite promise, however, lies in the western tip of South Carolina and can be bounded, for brevity, by the eastern line of Greenville and the southeastern line of Anderson counties.

Geography and Topography of the District

The area within these boundaries is cut by two definite gold-bearing zones and touches another at the North and South Carolina boundary line. The general trend of these zones is in a southwesterly direction from their most elevated position in the hills and mountains. The drainage of the area is southeasterly from the watershed of the Blue Ridge Range, consequently numerous small streams cut the higher zone and, in and near their origin, touch the third gold-bearing reach. Seneca River has its beginning, so far as the name is concerned, at the junction of Keowee and Little Rivers, on the east line of Oconee County, and follows a southerly course at the crossing of the Oconee County line. At this point the Seneca is the recipient of practically all the drainage of Oconee and Pickens Counties and has reached about 300 ft. in width. It is worthy of note that the junction of the Keowee and Little Rivers takes place at the north edge of one (the lower) of the two gold-bearing zones mentioned, and that the Seneca cuts this zone for a river distance of 9 to 12 mi., emerging from the zone area at the southeast Oconee County line. Further reference will be made to the topographical condition of this zone, which is at present contributing gold liberally to the bed of the Seneca along the section mentioned.

The headwaters, in numerous little tributaries of the Keowee and Little Rivers, cut the second-level zone ranging east by north above Walhalla and touch the third level in the mountain heights. The Seneca, along a section extending from Clemson College down to Maxwell's bridge, will have especial attention from the viewpoint of its possible dredging value. The basin at this point is undulating, and the bottom lands, or silts deposited by the river, have varying widths and an elevation of from 20 to 30 ft. above normal water level of the stream. No great indication of recent changes of riverbed position were observed, and the present channel may have an average total depth of from 16 to 40 ft., with water depth ranging from 4 to 25 ft. The stream is not sluggish, nor has it any observed rapids. There is a power dam some miles below the reach under discussion, but there is no backwater tendency evident.

The Geological Compositions

The geological aspect of the entire region invites the attention of the geologist as well as of the archæologist, for here, as in no other place in the United States, is laid bare a region of vast area, from the coastal plains to the coal measures, east to Maryland and west to the Gulf of Mexico, in stratified formation of an age probably preceding the Cambrian. Huronian is an apt term as applied locally to the age of rocks in the region of Lake Huron, the formation being apparent in general characteristics in many places, and the selection of the particular area under discussion was finally made very largely on the geological evidences. More nearly uniform uncovering by erosion of the ages was found here than elsewhere, and in this area it was possible to observe the gold-producing levels of the earth laid bare to an unusual degree. Furthermore, the operations of nature in its disseminations of the gold in this section can now be observed in all stages except those of the glacial and volcanic nature. Open fields, weather-worn and torn into hundreds of clay rivulets, can be observed delivering placer gold to lower levels; the protection of wooded areas holds deposits of former ages and still is acting to submerge them deeper; the slow process of oxidation is proceeding on many exposures of sulphide ores to roast them into the condition of delivering their free gold.

Mica schists, gneisses and granites are the apparent original formations, more recently cut by eruptive dikes of porphyry, diabase, perhaps diorite, pegmatite, etc. The region has all the appearance of the pre-Cambrian, and is known to geology as Alabama Island, having extended far into the Atlantic Ocean.

Stratification, as evidenced by zones or belts, has a regular trend N 22° E. Fissures are more or less regular in their general direction N 82° E, while the dip of the strata is southeast from 45° to 50°, and the dip for the fissures is north from 12° to 20° from the vertical

The general structure of the gold-bearing zones was observed to be strata veins, lenticular stringers and irregular disseminations inclosed in the gneiss and mica schists crosscut by occasional fissure veins, being practically the same indications as were noted at Dahlonega, Ga., Battle Branch and Knuckleville. Also, for similar citations, reference may be made to Adler Gulch, Mont., and Baker City, Ore., South Mountain, Pilot Mountain and Vein Mountain, N. C.

Mineralogy of the Ore Deposits

A regularity in the nature of the ores in the region is evident. They carry cubes and diffusions of gold-bearing limonite, hematite and magnetite. Many specimens, rich and with visible gold, were gathered on the surface. Many ores were examined that were rich in combined gold.

Sulphides are plentiful, and black sand prevails in the upper reaches of the streams, together with fragmentary iron-ore leachings to such an extensive degree that we were impressed with the possibility of practical operation with profitable returns of a machine that can be adapted for and used to concentrate and treat these fragmentary driftings. Something in the nature of a large water concentrator and cyaniding would be adaptable.

The work, as carried out, led us over many areas promising in surface indications, and, as previously mentioned, the generally exposed character of the formation was favorable to intelligent observation. Placer areas were encountered that give promise of profit if intelligently prospected and attacked.

Undoubtedly many veins are in position, having every indication that, with modern methods of treatment, they would yield great profit. A number of these have been recognized through their free gold, attacked with little or no knowledge of the rudiments of mining, and in some cases the leads have been lost, while in others depths have been reached that yielded, perfectly normally, combined gold values that could not be handled or appreciated by those who had undertaken the work. Of course abandon-

ment has been the rule. Wherever and whenever we have encountered these relics and seen the abandoned openings and ore piles, it has been noticed, also without exception, that where the conditions, geologically and mineralogically, were originally favorable, there could have been no failure under intelligent treatment. We realize that this is a broad statement, and we wish to qualify it by the admission that we have not visited every abandoned working in the whole of the gold-bearing region of the slope from the Blue Ridge Range to the coastal plains, but we can make the statement specific with reference to the detailed area reconnoitered.

Finally, the trend of the work led us most forcibly to an appreciation of the apparent dredging value of that portion of Seneca River already mentioned. Every reasonable evidence exists to indicate that the gold deposit here must be of such extent as to invite prospecting. The evidence of thousands of years of erosion in placer areas of a character to feed the stream liberally points to the conclusion that this section of the river should hold a vast accumulation. The general topography seems ideal. At this point it traverses, for about 6 mi. in a direct line or 9 mi. of river course, a deep basin having a transverse width of from 3 to 7 mi. on each side of the river bed and in which the erosion has been great and still continues. This portion of South Carolina has a yearly rainfall of about 55 in. The appearance of the river is that it presents lodgment of a soft bedrock far more perfect than any set of man-constructed riffles; certainly the gold never can have consistently escaped from the lodgment within any reasonably recent time geologically. It is a question only of the amount that has been thrown down.

The rolling elevations and benches receding from this section of the river carry placer gold in disseminations of varying degree, largely too limited for profitable hydraulicking, but so generally and widely distributed as to leave little question of river value worth while. Wide fields carry on their surfaces broken quartz fragments so plentiful that one can almost walk across on the pieces. Gullies and rivulets and roadways cut into schist and clay formations, and whole fields have been stripped of their soils and are still delivering gold to such an extent that after each rain new deposits can be found. We panned in a roadway in front of the residence of John Phillips, a farmer in this basin, consecutively at exactly the same point after two different rains. Each time the new driftings left by the rain were taken up completely, and each time they carried gold in good quantity, from 3 to 50 colors to the pan. In a gully where good placer-gravel indications are exposed, we panned as high as half-a-pennyweight to the pan.

THE SENECA RIVER FROM MAXWELL'S BRIDGE, LOOKING UPSTREAM

Various brooks and rivulets that run water all the time are sources of interest because of the gold that can be panned from their banks and beds. Indeed, some of these hold quite good promise of profitable sluicing on a small scale. Two illustrations are appended showing the character of some of the brooks and gullies mentioned,

and one showing the general appearance of Seneca River, the view being from Maxwell's bridge. The existence of such a great number of small sources that feed the gold to the river must have significance well worth thorough and conclusive investigation.

Dredge prospecting is a definite and dependable art. It opens or closes the way for conservative investment, and in this case the more one studies the conditions apparent superficially the more he is convinced of great possible value.

Commercial Coal Mining Near Seldovia, Alaska

Coal for commercial uses is being mined successfully near Seldovia, Alaska, on Kachemak Bay, according to a report just received by Secretary Lane from Anchorage, the southeastern terminus of the Government-built Alaskan railroad.

Under restrictions of the law and of the regulations established by Secretary Lane, a permit was granted last April to John A. Herbert, of Seldovia, to mine coal in the area of the Chugach National Forest. The land contains two workable beds of lignite, but is unclaimed and unoccupied for any purpose. Herbert began operations on May 1 and has built bunkers with a capacity of 500 tons, purchased scows for the transportation of the coal to Seldovia and run a drift to cut the vein of coal near the point of outcrop. His outlay was about $6,000. Up to Nov. 1, 1915, he had mined and marketed 700 tons of high-grade lignite, and he is continuing his operations during the winter.

Anaconda's Bureau of Safety

BUTTE CORRESPONDENCE

The Anaconda Mining Co.'s Bureau of Safety has just entered upon its third year, its history showing a gradual development and an increase in effectiveness. The work has been carried on under two main classifications—the installation of safeguards and the elimination of dangerous practices. The installation of safeguards is still in progress, and the bureau is now directing its efforts to have safeguards designed for machines and equipment before they are built or installed, so that the guard will form an integral part of the machine. It is of course more expensive to design and place a guard on a machine after the machine has been built and put in place than it would be to build the guard with the machine, and it is also a harder matter to make the guard fully effective and satisfactory for use by the operator.

However, the most important part of the safety-first work is the elimination of dangerous practices or carelessness, and the education of the foremen and men to think and act safely. In spite of the notorious recklessness and carelessness of metal miners, this has already been accomplished to a large extent in the Butte mines. Many men have been laid off for seven-day periods for violations of the safety-first rules, and the harsh penalty made necessary by continued indulgence in dangerous practices has shown very satisfactory results.

The official report, just issued for November, shows a marked decrease in accidents. During that month there was a total of 27 accidents in the Anaconda mines in Butte, accidents that incapacitated a man for 14 days or more being noted. Two of the accidents resulted in fatalities. These 27 accidents occurred during a total of 261,513 shifts, 1.03 accidents per 10,000 shifts. For December the bureau reported 19 accidents at the smeltery at Great Falls, where a great amount of construction work is being done and many new men are employed. At the Washoe reduction works at Anaconda there were 43 accidents in December, and at the Tooele plant of the International Smelting Co. there were 10.

A Dissertation on Flotation*

Before proceeding with the subject matter of this address, I wish to say a few words concerning the circumstances which have led up to its presentation tonight. I have just become associated, in a consulting capacity, with a newly formed corporation, the Maresnest Development Co., incorporated under the laws of New Jersey. This company has been formed to take over and introduce certain new and exceedingly valuable developments in flotation processes, due to an investigator hitherto unknown to the scientific public in connection with this field of work, Professor Petrologos Pseftis, of the University of Samarkand.

It seemed to me that an occasion like the present, when so many men eminent in the engineering profession were gathered together, would be a peculiarly suitable one at which to make public the many advantages offered by the new processes. I therefore approached your committee, who, after some discussion, enthusiastically endorsed the proposal. I may say that these gentlemen have since become stockholders. There is a small amount of stock, preferred, common or deferred, still unallotted, for which I shall be pleased to receive applications at the close of this meeting from those interested.

A brief historical summary of the subject will assist us in appreciating the nature of the new processes.

Leaving on one side for the moment the epoch-making discoveries of Professor Pseftis, it may safely be asserted that the principles underlying the flotation methods, as we understand them today, have been not only foreshadowed but put in practice on a large scale by men who lived and worked in the morning of the world.

The legend of the Golden Fleece and the Argonauts, for example, evidently refers to an attempt to recover gold by flotation, which turned out badly for the stockholders.

In Roman times tin was derived from Cornwall and the Scilly Islands (or as they were called in those days, the Cassiterides), by flotation; a complex aqueous solution of mineral salts, among which sodium chloride predominated, being used for the purpose.

In the story of the sword of Damocles we have a clear indication of the suspension of a metalliferous substance against the action of gravity by capillary attraction.

In more recent times we may quote as examples of flotation by means of bubbles of air or gas the South Sea Bubble, Bay State Gas and the various applications of heated air to the temporary lifting of values.

Instances of this kind could be multiplied indefinitely. In fact the obvious distinction between things that float and things that sink must have been one of the earliest experiences of our race and consequently it is not surprising to find in the practice of flotation an instance of prac-

*A lecture presented, with experiments, at the A. I. M. E. smoker, New York City meeting, Feb. 15, 1916, by Gilbert Rigg.

tical men anticipating and out-distancing the scientific investigator. Whilst the science of flotation, as you mining men understand it today, is of very recent origin, and is to a large extent dependent for its success on the nature and conditions of the values to be recovered, it is an old song on Wall Street and appears there to be entirely independent of the nature or even existence of values.

Flotation depends upon surface tension. What is surface tension? Before going into the mathematical and physical basis of this phenomenon, it will probably facilitate its comprehension if we proceed to describe some of its effects.

The natives of the upper Nile make use of this principle in catching the hippopotamus. They leave a large meal of dried beans for the hippopotamus to consume. After taking in a hundred pounds or so, the animal feels thirsty and goes down to the Nile for a drink. This so increases his surface tension as to largely increase his volume, and consequently displaces his load line. Under these circumstances he is unable to sink, and his mobility is seriously impaired. The values are then recovered by spearing.

Again we have the tension produced by the passage of an electric current. Severe tension has appeared on the surface in recent times as the result of currents flowing in the transatlantic cable. These effects, however, seem to be eliminated by repeating the passage of the current a sufficient number of times in opposite directions.

As a third example is the difficulty experienced in causing certain areas to become wet. The State of Maine is a familiar case. On the other hand there is a large class of materials which absorb water readily, such as irrigated lands and railroad stocks, while selective absorption of liquids is characteristic of mining engineers.

The tendency of valuable sulphide minerals to float is familiar to all mill-engineers engaged in table work.

When a principle as familiar as flotation has at length found its way into the Patent Office, and still more at length out of it, it is not surprising to find that its next step is into the law courts. This topic would not be complete without reference to the litigation that has accumulated. It is not unusual for men of a crude and primitive stage of culture to complain of the law's delay and to decry modern legal processes. A moment's consideration will convince us of the error of this mental attitude. No matter how ridiculous or futile a process may be, once it finds its way into a court of law, it becomes at once a source of revenue. If the earning power of patents were regarded from this point of view, a considerable change would be made in our estimate of the value of some recent products of human ingenuity.

As typical of this process of extracting large returns from the intellectual dump accumulated by the Patent Office, I may cite that most illuminating and classical case, The United States Ore Floating Co. vs. The American Gangue Sinking Co. The decision of the Supreme Court in this case has recently been handed down, and will well repay consideration. I quote as follows:

"The plaintiffs in the action have sought to show that by mixing the finely comminuted minerals with fish-oil, tar, molasses, hair-oil, boiler composition, laundry-blue, assafœtida, or any or all of these or the like, the fish-oil, tar, molasses, hair-oil, boiler composition, laundry-blue or assafœtida attach themselves to the valuable sulphide minerals and not to the valueless gangue minerals. And that further when air, or carbon dioxide gas, or any suitable gas is mixed with water and the minerals so treated be added thereto, that the bubbles of air, or carbon dioxide gas or other suitable gas will attach themselves to the valuable sulphide minerals by reason of the coating of fish-oil, tar, molasses, hair-oil, boiler composition, laundry-blue or assafœtida and so cause the valuable sulphide minerals to float at the surface of the water, from which they can be recovered by any suitable means.

"The defendants, in our opinion, have taken a radically different course. Their process consists in mixing the finely comminuted minerals with assafœtida, laundry-blue, boiler composition, hair-oil, molasses, tar and fish-oil, or any or all of these or the like, whereby the assafœtida, laundry-blue, boiler composition, hair-oil, molasses, tar or fish-oil do not attach themselves to the valueless gangue minerals but to the valuable sulphide minerals. And further, in mixing carbon-dioxide gas, or air, or any suitable gas with water, the bubbles of which do not attach themselves to the valueless gangue minerals by reason of the absence of a coating of assafœtida, laundry-blue, boiler composition, hair-oil, molasses, tar or fish-oil and do not prevent such minerals from sinking. The valueless gangue minerals, which do not take up the coating, are therefore free to sink and can be removed by any suitable means.

"We have been largely influenced in coming to a decision by the precedents established in the following cases: The Minerals Penetration Co. vs. Heavenless; Canner vs. the Split Mountain Appropriation Co.; the People vs. Jones, Brown & Robinson; and Kettle vs. Pott, Black intervening.

"In the People vs. Jones, Brown & Robinson, the court held that a sinking fund could not be applied to the flotation of a syndicate, thus establishing once and for all the basic distinction between things that float and things that do not. This principle was practically admitted by counsel for the defendant, who stated that it was a case of sink or swim for his clients.

"The case of Kettle vs. Pott, although an action for slander, bears directly on the point, relating as it does to the question whether the attachment of an attribute is essentially lowering or elevating. While the plaintiff in the action was non-suited, the court held that the principle involved was of the greatest importance and granted a new trial.

"In the case of Canner vs. the Split Mountain Appropriation Co., the plaintiff sought damages for alleged infringement of his patent. The master claim in the patent reads as follows:

" 'The recovery of the valuable minerals in the ore by causing the same to separate from the valueless gangue, this result being obtained by the separation of the former from the latter substantially as described.'

"The court held that the plaintiff had limited himself by this claim to a specific process, the conditions and methods of effecting which were laid down along definite and narrow lines. While admitting the hardship inflicted on the plaintiff by the defective drawing up of the claim the court held that the attempt of the plaintiff to extend the scope of the claim so as to cover the process employed by the defendant was *ultra vires* and not competent and must therefore fail. Notice of appeal was given, but was later withdrawn, the defendants paying Canner $10,000,000 in cash to cancel his claims with the right to

substitute ten (10) shares of Bethlehem Steel stock in lieu thereof at their discretion.

"The case of the Minerals Penetration Co. vs. Heavenless was heard before the Commissioner of Patents. The decision has not yet been issued.

"We are of the opinion that in view of these precedents there can be only one possible decision in this case. Judgment deferred accordingly."

It may be said, without any desire to flatter the learned judges who handed down this illuminating decision, that it is decisions of this kind that have placed the flotation processes in the position they occupy today.

Turning now from the legal to the technical aspect of the subject. The aim of the flotation processes may be described as the separation of the valuable from the valueless constituents of the ore by causing these two classes of material to assume different positions relatively to the earth's center through the interpolation of a medium either wholly liquid, or partly liquid and partly gaseous, the valuable minerals being centrifugally situated and the valueless minerals centripetally. To describe in detail the physico-chemical bases for the dynamic phenomena involved in the mass-transference of the metalliferous and nonmetalliferous substances dealt with would occupy far more time than the scanty two hours allotted me by your committee. The mathematical demonstration of the laws of flotation as given for the first time by Professor Pseftis, under the title of "Preliminary Notes on a Graph for the Positive or Negative Attraction of Two Solid Particles Situated in Space at a Distance Precluding Any Action Whatever of Either on Each," occupies two large volumes of the "Transactions" of the Philosophical Society of the University of Samarkand, and hardly lends itself to presentation in the concrete form of an abstract.

At the close of the lecture a large tank of water was unveiled, into which the experimenter began to pour various liquids out of different large bottles, each marked with a skull and crossbones, the contents of the tank being gravely stirred with a large wooden paddle. The solution turned purple, blue, black and was finally decolorized.

The lecturer then declared that the solution was ready for work, after which he showed a large chunk of what he said was galena, which he dropped on the floor with a convincing bang. He then picked it, or something else just as good, up from the floor, put it in the tank, and it floated. Two large blocks of cork were then produced—at least they looked somewhat like cork—placed in the tank, and they sank. This was declared to prove that Professor Pseftis' solution would therefore float anything having metallic luster and sink anything without.

Convincing photographs—that is, convincing to anyone who had never seen a photograph—or a mine—were shown of divers at work in a mine flooded with solution, the rock drills, wheelbarrows, picks, shovels and the metallic part of the ore floating to the top with such violence as to be completely ejected, whereupon they were caught in the treatment tanks. It should be fully understood that the divers had no difficulty in staying down, as they had cork sinkers on their diving costumes.

Professor Pseftis was unavoidably detained, but there was exhibited a photograph showing him with very neatly cropped hair and clad in a suit of horizontal dark brown and white stripes. It was plain that his detention was likely to last.

The lecture finally wound up in an altercation between Professor Treblig Girr, of Sweden (Gilbert Rigg), who delivered the dissertation, and a professional fly-by-night *entrepreneur* (William B. McKinlay) as to division of the spoils of the stock sales, interrupted by Melissa St. Claire Hicks, late of the Cœur d'Alenes (B. A. Robinson), who declared she was the original discoverer of the process, having found it out when etiolating the galena-stained shirts of some of her former boarders.

⁂

Ray Consolidated Copper Co.

The report of the Ray Consolidated Copper Co. for the last quarter of 1915 shows a production 17,195,533 lb of copper—5,894,441 lb. in October, 5,576,083 lb. in November and 5,725,009 lb. in December, a monthly average of 5,731,844 lb. In addition to copper from concentrating ores, there was a total of 560,123 lb. of copper in ores shipped directly to smelteries.

Ore milled during the quarter was 797,102 dry tons averaging 1.688% copper. Milling costs were 52.76c. per ton, mining costs 61.08c. and coarse-crushing costs 3.828c. per ton. Average cost of net copper was 9.625c. per lb., including a charge of 12.5c. per ton of ore milled for the retirement of mine-development cost. Credit is also made for the dividends of the Ray & Gila Valley R.R., revenues from gold and silver and other miscellaneous income.

Total profit for the quarter was $1,778,568; dividends paid, $777,482. Earnings are based on a price of 20.213c. per lb. for copper. Unsold copper and that in transit are carried at 13.5c. per lb. The eighth quarterly dividend amounting to 50c. per share, based on an increase of annual dividend rate from $1.50 to $2 per share, was paid on Dec. 31, making the total dividends paid from the beginning of the company's operations to the end of this quarter, $4,593,145. During this quarter the employees were placed on a sliding wage scale depending on the price of copper.

⁂

Report of Library Board of the United Engineering Society

The report of the Library Board of the United Engineering Society for 1915 is of special interest because of the increased value of the library, through the library-service bureau organized by the board last year. The great storehouse of technical data in the library at the United Engineering Societies Building, 29 West 39th St., has thus been made much more valuable to members living away from New York and even to those who are in the city, but are too busy to conduct personally the search for literature pertaining to a given subject.

After the organization of the library-service bureau in May, 1915, there were 679 requests for library service, including 307 reference lists, 71 translations and 301 photostat orders embracing 2,500 prints. During the year there were 12,820 visitors, of whom 17% made use of the library in the evening. The library board is considering the publication of a general engineering index covering all branches of technical literature; the staff expense is estimated at $11,700 and the annual printing expense at $11,340. The regular library budget for 1916 is estimated at $16,500—practically the same as the library's 1915 expense; the revenue was about $1,000 in excess of this.

Recent Progress in Electrical Smoke Precipitation*

By F. G. Cottrell

SYNOPSIS—A brief historical review of the work done on the phenomenon of agglomeration of floating particles by an electrical discharge, and of the final adaptation of this phenomenon to the commercial problem of precipitating dust from entraining gases.

In the report of the Smithsonian Institution for 1913, the author presented, under the title "Problems in Smoke Fume and Dust Abatement," a brief summary of smoke abatement in general, followed by a more detailed history and discussion of methods of electrical precipitation in particular.

At the request of the secretary of this section it is attempted in what follows briefly to reproduce just enough of that article to give a clear conception of what the process of electrical precipitation is, a general idea of what degree of industrial importance it had attained up to the fall of 1914, when the article in question was written, and then to follow this with a brief report and discussion of progress made since that date, with special reference to the possible significance of these methods in the future to other Pan-American countries. A bibliography of the subject is appended, while in the text direct references are limited to a few articles giving detailed descriptions of individual installations.

So far as known the earliest suggestion to use electricity to precipitate smoke was made by Hohlfeld, a teacher of mathematics in the Thomas School at Leipzig, Germany, in 1824. He found that if he electrified a wire hung in a bottle filled with smoke, the latter rapidly cleared and a corresponding deposit was found on the sides and bottom of the bottle. However, it was not until 1884, when Sir Oliver Lodge independently rediscovered and urged the use of these phenomena for smoke and fume abatement and the clearing of fog, that serious application to industrial questions was actually attempted. At this time patents were taken out by A. O. Walker, in England and several other countries, and large-scale experiments were made at his lead smeltery in Wales, in an attempt to settle the lead fumes by charging from a large Wimshurst influence machine a system of metallic rods and points hung in the flues of the smelter, but the electrical apparatus then available did not prove equal to the requirements of industrial practice and the work had to be abandoned. During the next 20 years occasional attempts seem to have been made here and there, and a few patents on details and modifications of methods were taken out, but apparently no permanent commercial installation resulted.

Some 10 years ago, while studying various methods for the removal of acid mists in the contact sulphuric-acid process at the University of California, the author had occasion to repeat the early experiments of Lodge and became convinced of the possibility of developing them into commercial realities. The subsequent work may fairly be considered as the reduction to engineering practice as regards equipment and construction of the fundamental processes long since laid open to us by the splendid pioneer work of Lodge—a feat vastly easier today than at the time of Lodge and Walker's original attempt.

*A paper presented at the Second Pan-American Scientific Congress and reprinted by permission.

Theory of Electrical Precipitation

The precipitation of suspended matter, whether in gases or liquids, may be accelerated by electricity in the form of either direct or alternating current, but the mode of action and the type of problem to which each is best applicable differ in certain important respects.

Where an alternating electromotive force is applied to a suspension, the action consists for the most part in an agglomeration of the suspended particles into large aggregates out in the body of the suspending medium and a consequently more rapid settling of these aggregates under the influence of gravity. Alternating current may thus be used to advantage where the masses of fluid to be treated are fairly quiescent and a simple agglomeration of the suspended particles into larger aggregates is sufficient to effect separation by gravity or otherwise.

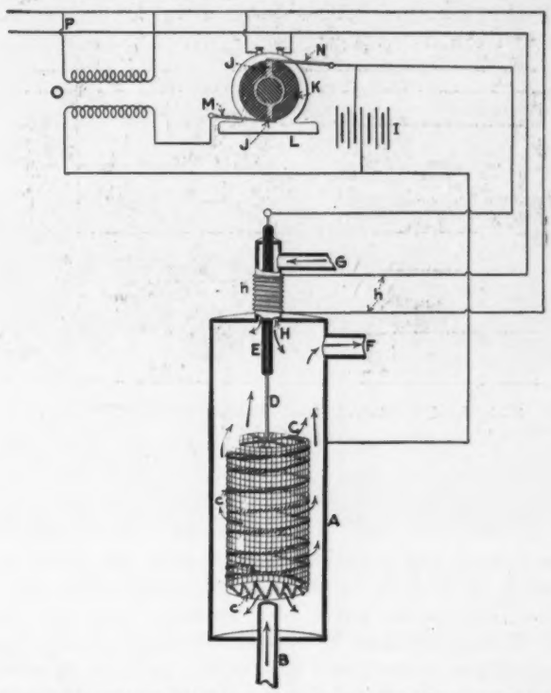


FIG. 1. DIAGRAMMATIC VIEW OF COTTRELL TREATER

In the case of the large volumes of rapidly moving gases in smelter flues, the agglomerating and settling process is, however, too slow even when the flues are expanded into as large dust chambers as are commercially feasible. It is in such cases that unidirectional current methods have been particularly important.

If we bring a needle point connected to one side of a high potential direct-current line opposite to a flat plate connected to the other side of the line, we find that the

air space between becomes highly charged with electricity of the same sign as the needle point, irrespective of whether this is positive or negative, and any insulated body brought into this space instantly receives a charge of the same sign. If this body is free to move, as in the case of a floating particle, it will be attracted to the plate of opposite charge and will move the faster the higher its charge and the greater the potential gradient between the point and plate.

Even if there are no visible suspended particles, the gas molecules themselves undergo this same process, as is evidenced by a strong wind from the point to the plate, even in perfectly transparent gases. The old familiar experiment of blowing out a candle flame by presenting it to such a charged point is simply another illustration of the same phenomena.

While gas molecules themselves are thus driven across the electric field precisely as are particles of solids or

FIG. 2. ORIGINAL COTTRELL EXPERIMENTAL APPARATUS

liquids, still of course they cannot be deposited on the plate electrodes and thus removed from the gas stream as are the solid and liquid particles. Thus before we can remove any given constituent from the gases to be treated, it must be in the state of a suspended particle, or droplet, and not a true gas. In many cases this change may be accomplished by a relatively small change in the temperature of the gases as a whole, and thus a series of two or more electrical treatments on the same mass of gas at successively lower temperatures will effect a separation of different products. Also, as later noted in specific cases, it is sometimes very convenient to introduce an absorbent into gas mixtures in the form of fine powder, or a fine mist of liquid particles which almost instantaneously become saturated with the constituent to be removed and can then be precipitated out with their burden of absorbed material.

As already indicated, the first step toward practicability was of necessity a commercially feasible source of high-tension direct current. The obstacles to building ordinary direct-current generators for high voltages lie chiefly in difficulties of insulation, and if this is avoided as to individual machines by working a large number in series, the multiplication of adjustments and moving parts intrudes itself. On the other hand, high-potential alternating-current technique has in late years been worked out most thoroughly, and commercial apparatus up to 100,000 volts and over has been available for some years in the market.

The procedure actually used in the installations hereinafter described is diagrammatically illustrated in the early Patent Office drawing (Fig. 1) and consists in transforming the alternating current from an ordinary lighting or power circuit *P* up to some 20,000 to 75,000 volts through the transformer *O* and then commutating this high-potential current into an intermittent direct current by means of a special rotating contact maker *J* driven by a synchronous motor *L*. This unidirectional current is applied to a system of electrodes in the flues carrying the gases to be treated. In the particular form shown in the drawing, the wall of the chamber *A* itself acts as one electrode, the other electrode *C* being suspended within it. The heating circuit *H* and inlet for clean gas *G* are merely for protection of the insulation from condensation of acid and moisture.

The electrodes are of two types corresponding to the plate and point in the experiment cited. The construction of electrodes corresponding to the plate presents no special problem, as any smooth conducting surface will answer the purpose. With the pointed, or discharge, electrodes it is quite otherwise, and the working out of practical forms for these proved the key to the first commercially successful installations.

The very phenomena of so-called corona loss or direct leakage from the wire into the air on high-tension transmission lines, which are today the chief stumbling block of the power companies in going very far above 100,000 volts on these lines, become exactly what is desired in the processes of precipitation, and with the voltages now used a bare metal wire of moderate size or the relatively thin edge of a metallic sheet may be to furnish an excellent discharge.

The construction and arrangement of the electrodes, as also of the chamber containing them, naturally vary widely with the conditions to be fulfilled under the varied applications to which the process may be put. All plants thus far erected may, however, for convenience be classified under two general heads—those in which the collecting electrodes are plates hung in a flue with discharge electrodes between them, and those in which a system of pipes carrying the gases act as the collecting electrodes themselves, one or more discharge electrodes being placed axially within each. Of late there seems to have been rather a tendency toward the latter type in new installations, largely on account of facility of construction. The accompanying photographs give perhaps a better idea of the gradual development of the work than any detailed description that would be possible in the space here at command.

Fig. 2 is the apparatus used for the original laboratory experiments in the spring of 1906. Sulphuric-acid mist was generated by bubbling the gas from the little contact sulphuric-acid plant, seen on the table, through water in the U-tube beneath the inverted glass bell jar[1], whose inner walls were quickly wetted sufficiently with acid to act as the collecting electrode, a wire being inserted alongside of the stopper through which the U-tube connected with the bell jar and served to connect the jar walls to the induction coil on the left, the latter acting as the step-up transformer *O*. This coil received alternating

[1]The letters in parenthesis refer to corresponding parts in the diagram (Fig. 1).

current at 110 volts from the lighting circuit and gave about 3,700 volts at its secondary. The other high-potential terminal of the induction coil was connected to the discharge electrode *C* within the bell jar through a make-and-break *MJM* operated by the synchronous motor *L*. This last was improvised by substituting a plain iron cross for the squirrel-cage armature in an ordinary fan motor operated from the same 110-volt line as the induction coil and brought into step by the induction motor on the right. A momentary contact with the discharge electrode was thus established once each complete cycle at the peak of the voltage wave and served to charge this electrode to the maximum voltage of the line, always with the same polarity.

As previously stated, electrical precipitation takes place no matter whether the discharge electrode is made the positive or negative, and the direction of the discharge and deposit is independent of the polarity and determined only by the size, shape and surface of the opposing electrodes; but it is found in practice that the negative discharge is much the more stable and can be run at higher current without danger of disruptive discharge, so that it has now become standard practice to make the discharge electrodes the negative and the grounded collection electrodes the positive. In order to help maintain the charge on the electrode in the interval between these contacts, the Leyden jar *I* seen in the picture was connected in parallel with the electrodes. The wire leading to the jar walls, or collecting electrode, was usually grounded for convenience and safety, as in fact has been done throughout all the practical installations. This leaves but one high-potential conductor to deal with in each precipitation chamber and greatly increases the safety of operation.

Fig. 3 is a closer view of the precipitation chamber through which the acid fume is being blown at the rate of about 20 liters per minute, the electric current being shut off the apparatus. Fig. 4 shows the effect of turning on the electric current with the same gas steam still flowing.

The discharge electrode in this case consisted of a cylinder of wire screen *C* wrapped with a few turns of asbestos sewing twine *c* and suspended by a wire passing through a glass tube, as shown. The suspended particles of acid were driven away from the asbestos filaments and deposited on the walls of the bell jar, finally running into the U-tube below.

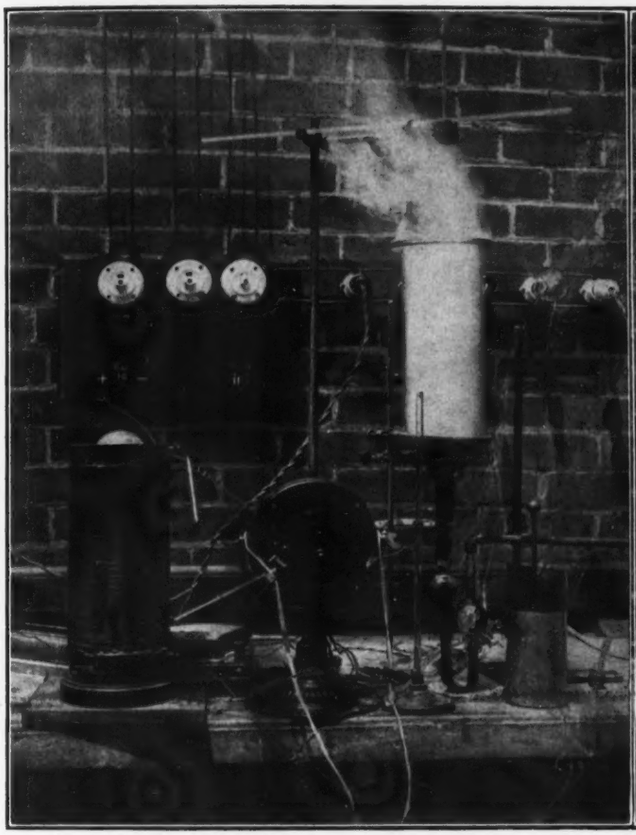


FIG. 3. FUME PASSING THROUGH COTTRELL APPARATUS—20 LITERS PER MIN.

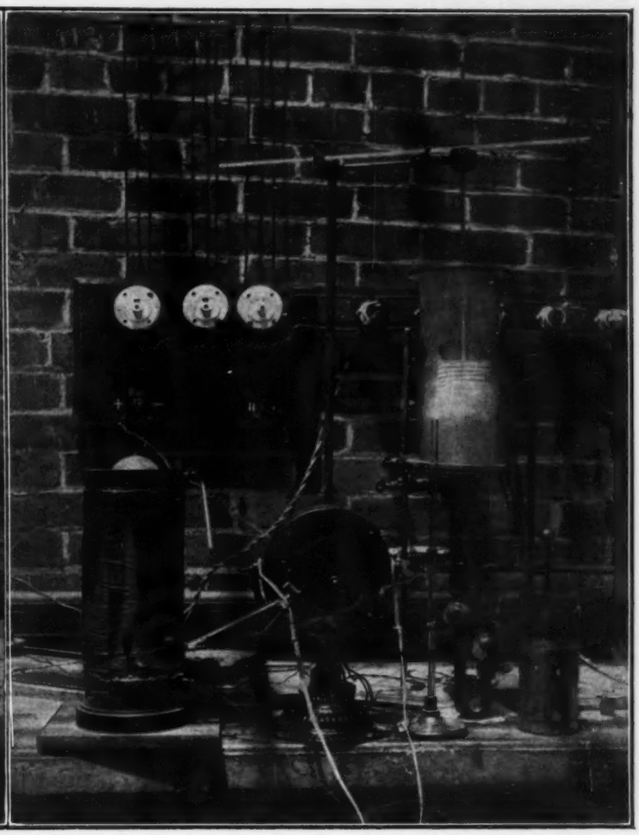


FIG. 4. SAME FUME PASSING, BUT WITH ELECTRIC CURRENT TURNED ON IN TREATER

These experiments led a few months later to the installation of the first commercially successful unit for electrical-fume precipitation at the Selby smeltery, near San Francisco. This installation has been in steady operation ever since, treating 5,000 to 10,000 cu.ft. of gas per min., coming from the kettles of boiling sulphuric acid in which doré bullion is parted. The material to be removed from the gases is the fine mist of sulphuric-acid particles aggregating when collected as much as 2 gal. per min., which formerly passed out of the stack as an extremely irritating dense white cloud.

Following the rapid and successful working out of this installation came several years of hard and ofttimes discouraging work in extending and applying the process to other and larger aspects of the smeltery-fume problem. Most prominent among these undertakings was that at the

Balaklala plant of the First National Copper Co., at Coram, Shasta County, Calif. Over $100,000 was there spent in the erection of an electrical precipitation plant to treat the total gaseous output of the smeltery, amounting to a quarter of a million cubic feet per minute. This was the first really large installation and remained in operation for about nine months, during that time recovering by far the greater part of the dust and visible fume carried by the gases, although the operation of the process was not then under as thorough control as it later became through more extended experience. The work at this plant and the attending circumstances were thoroughly discussed in two former papers[2] and will not be dwelt upon here. The smeltery finally closed because of continued litigation with the neighboring farmers, the issue being clouded by the difficulty of distinguishing between damage due to visible fume, which the precipitation process was aimed to remove, and that due to sulphur dioxide, which as a true gas it makes no claim of removing.

This plant, while not able to save the Balaklala smeltery from an eventual shutdown, formed a very important link in the development of the processes to their present status. The interest of the smelting companies up to this point depended almost entirely on the hope of eliminating smoke

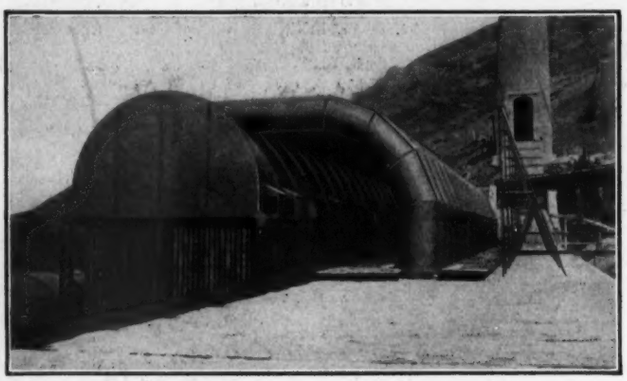


FIG. 5. PRECIPITATOR ON CONVERTER FLUE, GARFIELD, UTAH

as a nuisance and its attendant litigation with their neighbors; and had it not been for the life or death struggle that this meant to them, it is probable that the success of the electrical processes might have been delayed many years longer.

Once brought to this stage, however, the process began to attract attention from the purely financial consideration of metal and other values being lost up the stack and of possible modifications of standard operating conditions which the application of electrical precipitation might permit in other parts of the works. A good illustration of this is the installation on the copper converters at the Garfield smeltery, near Salt Lake City, Utah, fully described by its builder, W. H. Howard, in a paper presented at the Salt Lake meeting of the American Institute of Mining Engineers, August, 1914.[3]

Fig. 5 shows this plant just before its completion and connection to the new stack seen in the background. The gases from the converters, amounting to about 200,000 cu.ft. per min., reach the apparatus through the steel flue, a glimpse of which is just caught at the lower left-hand corner of the picture. From here they pass to a hopper-bottomed steel chamber below the bank of 2,520 vertical 5-in. by 10-ft. steel pipes seen between the first-mentioned steel flue and the large receiving brick flue, from the top of which the picture was taken. The pipes act as the grounded collecting electrodes, and through the axis of each is hung from a system of insulated bars above, a No. 10 iron wire as discharge electrode. These are maintained at about 25,000 volts from a transformer and rectifier station situated some 200 ft. to the right of the flues and not shown in the picture. The installation, which has now been in successful continuous operation for nearly two years, consumes from 60 to 80 kw. and collects several tons of fume per day, running over 50% lead, besides precious metal and other values. From time to time each section in succession is shut off by closing the damper in its downcomer to the brick flue, and the pipes are struck by a system of swinging hammers suspended between them and operated by a lever seen at the right. The deposit of fume thus falls from the inside of the pipes into the hoppers below and is drawn off into cars.

Perhaps a more concrete idea may be had of the mode of operation of this system from Figs. 6 and 7, which show the two rows of 12 pipes each with which the problems on this particular fume at Garfield were first tested out before proceeding with the large permanent construction. These pipes were duplicates of those used in the final installation. Some of the converter gases were drawn from the main flue with a fan and discharged into a header below these pipes. The discharge electrodes were weighted wires, hung through the pipes from the insulated bars seen above them. The two pictures show the difference in appearance with the electric current on and off, while the same gas current flows through the pipes. A pile of the collected fume is seen at the left.

The application of electrical precipitation to converter gases is of special interest because of the concentration of lead in these gases. Heretofore whatever lead came into copper smelters was usually blown off and wasted at this point. The high temperature and varying acid character of these gases made the use of baghouses expensive and difficult. The ready availability of the electrical process not only makes it possible to recover the lead now being lost from the stacks of copper smelteries, but should also make it possible to handle at a profit some mixed ores and low-grade siliceous lead ores that have heretofore been considered valueless.

The Garfield plant was the first large installation of multiple-pipe type, and the pipes are of smaller diameter and consequently operate at lower voltage than any later installations, most of these having pipes of 10 to 16 in. diameter with applied voltages ranging up to, or even exceeding, 100,000. At Anaconda, Mont., experimental work on roaster gases was even carried to a pipe 4 ft. in diameter and 40 ft. high, using potentials of approximately 240,000 volts. While the results obtained were satisfactory and entirely in line with those on smaller pipes, the increased difficulties and expense in maintaining apparatus for these extreme voltages, together with the fact that to get the full efficiency of a pipe of large diameter it is apparently necessary also to increase its length as compared with pipes of smaller diameter, led to the conclusion that the dimensions now generally

[2] "Journ. Ind. and Eng. Chem.," Vol. 3, pp. 542-50, August, 1911. "Report Smithsonian Institution for 1913," pp. 653-85.

[3] "Trans. A. I. M. E.," Vol. 49, pp. 540-60, 1914.

in use, as already cited, better suit economic requirements for the present stage of general technical development.

Fig. 8 illustrates a treater of 48 pipes, 12 in. diameter by 12 ft. long, at the works of the Duquesne Reduction Co., in Pittsburgh, Penn., which collects oxides and chlorides of zinc, lead, tin, etc., from reverberatory furnaces, melting a wide range of drosses and metal scrap purchased in the open market. This unit handles about 9,000 cu.ft. of gas per min. at 200° to 250° C.

Fig. 9 shows the general arrangement and construction of a precipitation plant over a set of driers for flotation concentrates at the International Smelting Co.'s plant at Inspiration, Ariz. These concentrates being very fine and high-grade, it was necessary to guard to the utmost against dust losses, and this was the occasion for putting in the precipitators. There are 12 separate units, each of 20 pipes 12 in. in diameter. Fig. 10 shows one end of the transformer and rectifier gallery of the same plant. This plant began operation last May and has given perfect satisfaction throughout. The converter department of this same smeltery is also equipped with precipitation apparatus consisting of 12 units of 64 pipes each and treats about 250,000 cu.ft. of gas per min. at 140° C. when running at full capacity. There is no lead to speak of in these ores, the copper and precious metals alone being the values sought in the dust and fume.

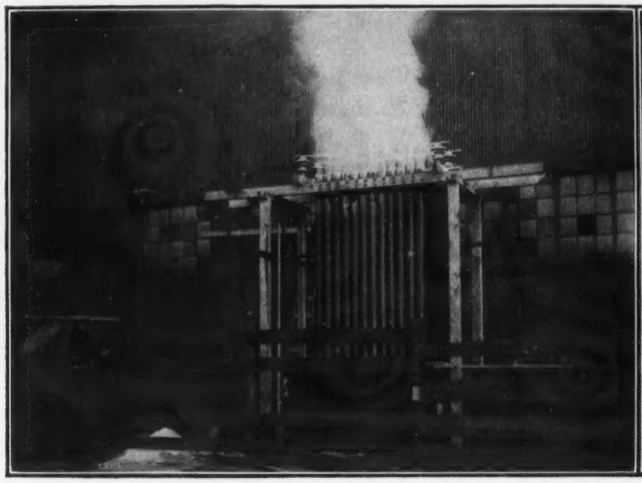


FIG. 6. EXPERIMENTAL APPARATUS AT GARFIELD; CURRENT NOT ON

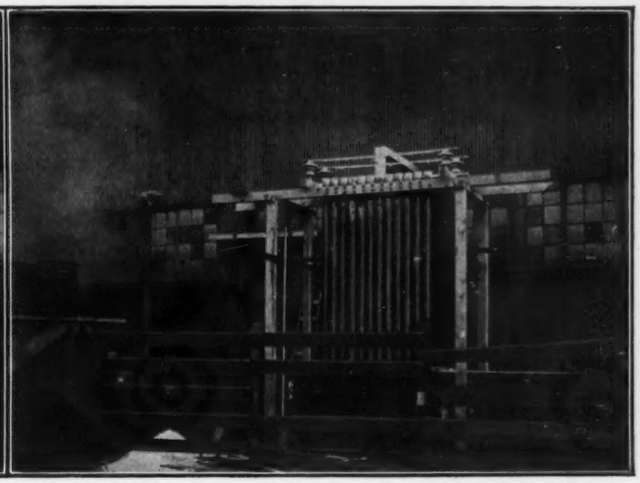


FIG. 7. SAME GASES PASSING, BUT CURRENT TURNED ON

Among other recent smeltery equipments worthy of mention are two at the Consolidated Mining and Smelting Co.'s works at Trail, B. C.—one on the lead blast-furnace gases and one on the roasters—the former having been in operation since April, 1914, and the latter since July, 1915, one more on another department of the plant being now contemplated.

Construction is also just being started on a set of units to treat 400,000 cu.ft. of gases from the new roaster plant at the Anaconda smeltery, in Montana. This will represent some interesting new features in methods of construction aimed at saving in first cost. These consist chiefly in a substitution of a parallel arrangement of light corrugated sheet-iron plates for the individual pipes of the standard multiple-pipe type of treater. In addition to this the experiment will be made of using larger individual units; that is, rectifying heavier currents over each individual rectifier than has heretofore been attempted in regular practice. Eventual enlargement of this roaster installation, as well as extension of the process to other departments of the plant, is also being planned for in the near future.

The first installation in Mexico is now under construction for the Compañia Minera de Peñoles and is to collect fume from the treatment of its ores.

With the high prices of zinc that have obtained of late has naturally come a much closer watching of losses. The brass founders were among the first to realize this and wish to recover the zinc oxide from their melting-furnace gases. The Rome Brass and Copper Co., at Rome, N. Y., is the first to install such apparatus, which is now under construction and consists of three sections of 16 pipes each. These pipes are 18 in. diameter by 12 ft. long, and the apparatus is to handle the gases from 30 fires in the brass-casting shop. Similar equipment at several other brass foundries is now also being planned.

At the River Smelting and Refining Co., of Florence, Colo., a plant of 70,000 cu.ft. per min. capacity has recently been installed to collect lead and zinc fumes from a lead blast furnace running with particularly hot top.

During the past year a number of installations have been put in, both in this country and in Europe, particularly in Germany, for cleaning roaster gases in sulphuric-acid plants.

Another application which this also suggests is the purification of sulphur-burner gases in paper mills, where the presence in these of traces of sulphuric acid is looked upon as very detrimental and often hard to control. This might also make the burning of pyrites in place of elemental sulphur practicable in some of these works.

Another application to the paper-pulp industry has already developed. This is the recovery of alkali salts from the waste-liquor-evaporator gases in the so-called alkali process. An installation of this kind, designed to treat 90,000 cu.ft. of gas per min., which is expected to collect some 20 tons per day of sodium salts, is just about to be installed in Canada.

The first installation to handle gases from Dwight-Lloyd sintering machines went into operation at the International Smelting and Refining Co.'s plant at Tooele, Utah, in December, 1914, on two machines representing about 20,000 cu.ft. of gas per min., and this is now being

extended to include the entire equipment of the Dwight-Lloyd department, requiring capacity for over 100,000 cu.ft. of gas per min.

Another industry into which the electrical processes first came purely to abate a nuisance, but where they have in practice actually shown a profit, is that of portland cement manufacture.

At the plant of the Riverside Portland Cement Co., near Riverside, Calif., the orange growers in the vicinity had been for some years in controversy with the cement plant over the question of dust blown out of the stacks from its rotary kilns. The company had already spent over a million dollars in attempts at remedial measures and purchase of land effected, but was still seriously threatened with injunction proceedings.

In the summer of 1911 experimental work on electrical precipitation was begun at these works, and the complete equipment of the plant with the system to treat nearly a million cubic feet of gas per minute at a temperature of about 450° C. was finished in January, 1913, since which time it has operated entirely under this system, maintaining over 95% recovery of the dust formerly discharged, according to testimony presented by the orange growers' own experts at the last hearing of the case a few months ago. The company had assumed that this degree of successful compliance with the growers' demands would be reasonable and satisfactory to all concerned, but the court held otherwise, and the original installation is being further improved and extended in the endeavor to take care of this last 5%.

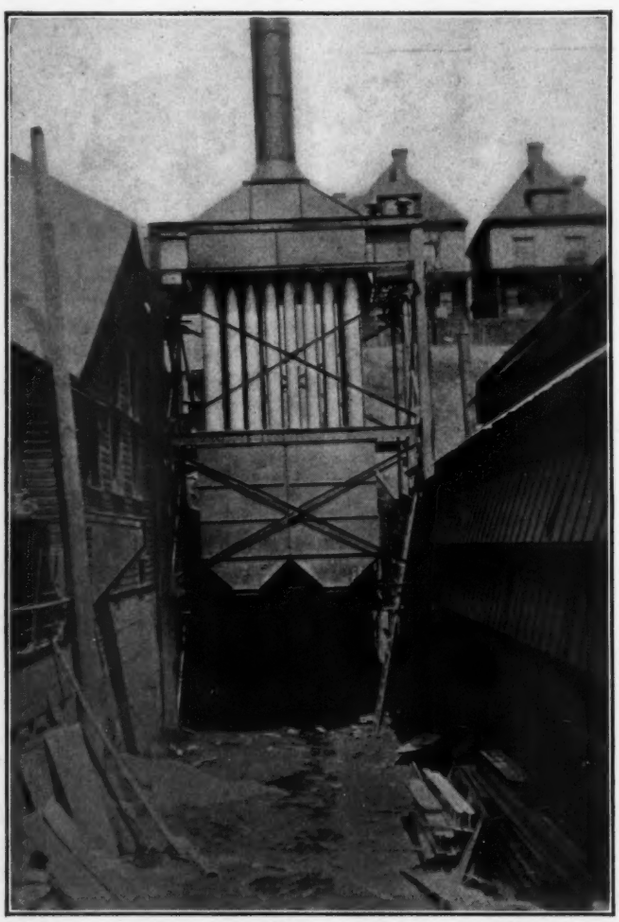


FIG. 8. COTTRELL APPARATUS, DUQUESNE WORKS

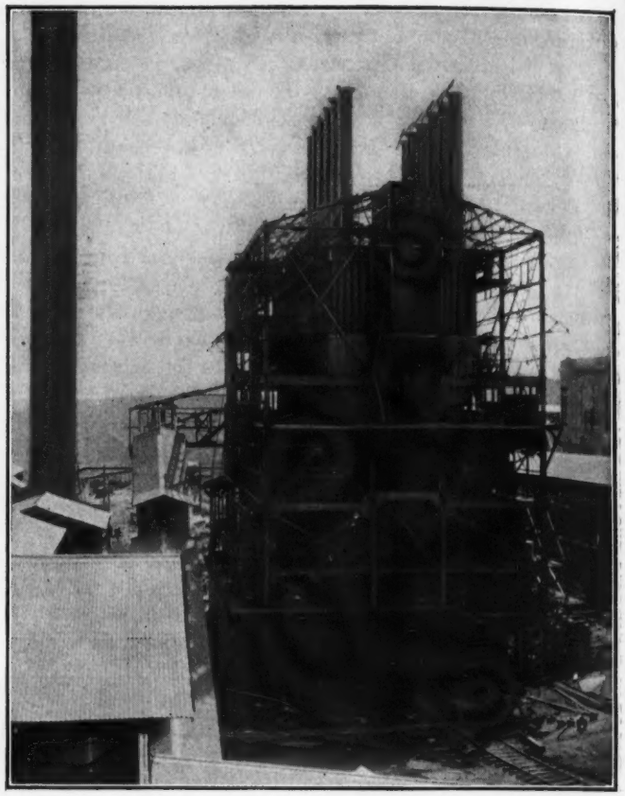


FIG. 9. DRIER AND PRECIPITATOR UNDER CONSTRUCTION AT INSPIRATION

The mill has a daily capacity of over 5,000 bbl. of cement, and the present treater equipment collects in the neighborhood of 100 tons of dust per day. The treaters are of the horizontal-flue and plate type and were built on top of the main kiln building, as this was the only available space at the time of erection.[4] Had they been planned for when the mill itself was built, a much more convenient and economic construction could have been adopted. Fig. 11 shows the construction of the equipment for three out of ten kilns of the original plant under way, the old stack of the fourth kiln just appearing at the right of the picture.

The most interesting development at this plant has been the recovery of profitable potash values from a product that was originally viewed as a nuisance and an expensive one at that. There is less than 1% of potash in the original raw mix going to the kilns, and no significance had ever been attached to the presence of this constituent by the company. After starting up the precipitators it was found that the dust collected averaged as a whole some 3 to 5% potash and that its proportion was higher in samples taken from the outlet than from the inlet end of the treaters. Furthermore, nearly the whole of it was now in a water-soluble form, whereas in the original raw mix it was all insoluble.

At first all dust collected was simply returned to the raw-mix bins and thus found its way back through the same kilns, but later a separate new kiln was installed and the dust from all the other kilns mixed with enough new raw mix to make up a full daily charge for the new kiln, and on this latter the separate multiple-pipe precipi-

[4]For detailed description see P. S. Taylor, "Journ. Elect. Power and Gas," Mar. 14, 1914.

tator, shown in Fig. 12, was installed. From this is now being collected 3 to 4 tons a day of dust and fume containing about 30% potassium sulphate, and which, it is understood, has been contracted for by a local fertilizer factory at a rate which will pay for the total precipitation equipment of the mill in from three to four years. In this plant the potash was of course merely an accidental constituent of the raw materials, and there are probably many other mills where fully as high potash concentrations may occur in the present feed to the kilns; but the question also naturally arises as to whether it may not be well worth while to consider the cement and potash industries in a larger mutual relationship when planning new mills in the future, and particularly in considering the available sources both for potash and cement materials. By using feldspathic material high in potash in place of clay now usually employed in the raw mix, it is not difficult to conceive how the cement might itself become almost the by-product.

In the matter of ordinary coal smoke it is of course realized that the proper remedy in the vast majority of cases is better combustion with the consequent non-production of smoke, instead of trying to collect it after produced. Still, there are probably a few special cases where, for the present at least, the necessary control of combustion conditions may be more difficult and expensive than the collection of the smoke by electrical precipitation and disposal of the soot so collected. In former reports the earlier experiments in this direction have been already referred to. The lack of any considerable value in the substance collected has made it relatively harder to get energetic development along this line than in most others mentioned, but now at last it seems as though the subject was being more definitely taken hold

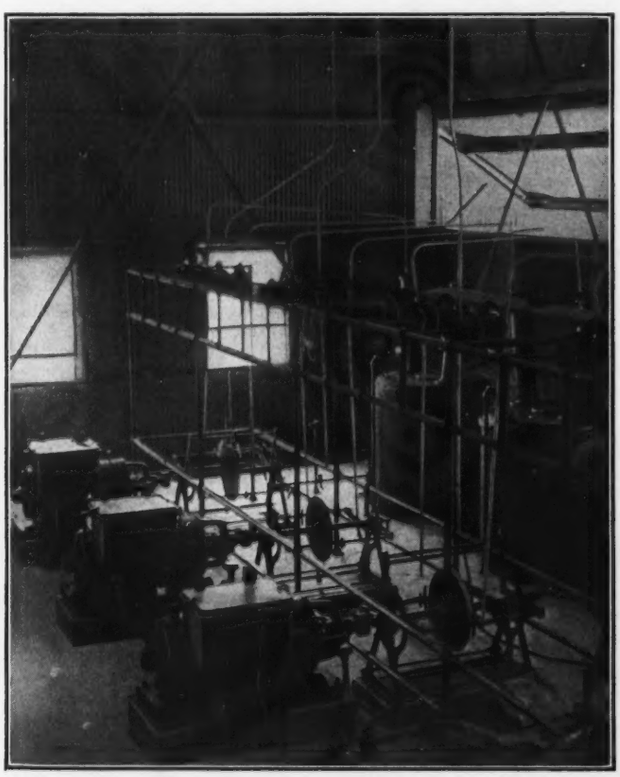


FIG. 10. TRANSFORMERS AND RECTIFIERS AT INSPIRATION SMELTERY

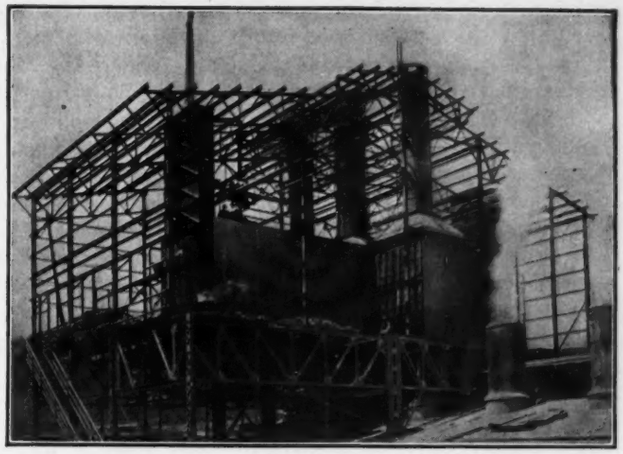


FIG. 11. CONSTRUCTION OF PRECIPITATORS, RIVERSIDE CEMENT PLANT

of with both determination and resources to push through to a conclusion. The Pennsylvania R.R. is equipping one of its roundhouses at Pittsburgh for that purpose, and similar work in other parts of the country is rapidly developing.

Somewhat related to the coal-smoke problem is also that of detarring and cleaning illuminating and coke-oven gases. The Semet-Solvay Co., it is understood, has been making considerable progress in this at some of its works along the lines developed by Steere, using alternating-current treatment followed by mechanical filtration, while for the cleaning of illuminating gas successful demonstration of the regular direct-current process has been made at the Vancouver, B. C., Gas Works; also the Portland Gas and Coke Co., of Portland, Ore., has had one of the usual direct-current units of 25,000 cu.ft. per min. capacity in successful operation since last April on the exit gases from its briquetting plant, collecting about 2½ to 3 tons of tar per day.

Application of the process to the cleaning of iron blast-furnace gas is another one of the most attractive prospects for future development, and some progress has already been made toward the construction and testing of equipment in connection with iron blast furnaces, but the abnormal conditions obtaining in these plants since the outbreak of the European War have delayed the completion of the work as originally mapped out, and a definite report on the results is therefore not available at present, although the subject is at last again receiving the attention it deserves and definite results are hoped for soon.

At the outset electrical precipitation was usually looked at only as a last resort to be used on gases too hot or corrosive to admit of filtration through bags or similar simple mechanical treatment, but with the gradual improvement and simplification of apparatus and wider familiarity with its operation, the process has been extended to one field after another until it has reached even the ordinary problems of ventilation. An interesting equipment of this kind, for example, went into operation last October at the works of the Winchester Repeating Arms Co., in New Haven, Conn., to clean 55,000 cu.ft. of air per min., drawn from sand-blasts, carding and buffing wheels and brazing furnaces. By thus being able in cold weather to return this air to the rooms from which it was drawn, instead of having to heat an equal

volume of outdoor air for the purpose, a saving of steam is effected which pays a good return on the investment.

In the discussion of the principles underlying the process it was pointed out that it has to do primarily with the separation of mechanically suspended solid and liquid particles from gases and is not of itself available for separating one gas from another. In certain cases it may, however, become a very important indirect aid for this purpose. Thus, for example, at the Hooker Electro-Chemical Co.'s bleach factory at Niagara Falls great difficulty had been experienced in removing the last traces of chlorine from the gases leaving the chloride-of-lime chambers, and complaints from neighbors were becoming serious.

Such very small traces of the gas were so objectionable that an unusually thorough scrubbing of the gases was necessary. The method finally adopted, which has proved eminently successful, is to blow into these

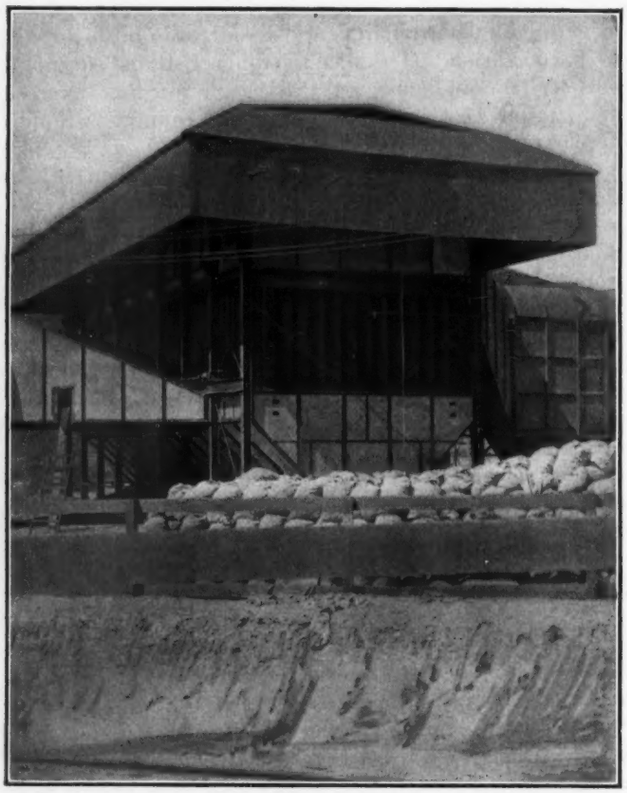


FIG. 12. RICH POTASH-DUST PRECIPITATOR, RIVERSIDE CEMENT PLANT

gases a relatively small amount of slacked lime in impalpable powder, which thus comes into the most intimate contact with every part of the entire mass of gas, instantly and completely absorbing the chlorine. A little farther along in the flue the gases pass through the electrical precipitation apparatus, which removes the lime dust with its chlorine, and this is then added to the regular charge of lime going to the absorption chambers of the works, and thus nothing is lost. Here again, in this way improvements originally aimed purely at suppression of a nuisance, which were looked upon merely as an additional but unavoidable expense, have proved actually a source of profit.

In this necessarily very sketchy outline of the work it has only been possible to pick here and there from the large number of problems that have developed in the past ten years, and more especially in the past two or three, a few of the most suggestive and to call attention to their implications rather than their detailed relationship to the industries which they affect.

For the convenience of those who may wish to follow the subject further, a bibliography is appended which, though not professing to be complete, will, it is hoped, be found of service in locating the rather widely scattered literature on the subject.

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Details of Practical Mining

Semiautomatic Safety Gate for Mine Shafts

By James C. Bennett*

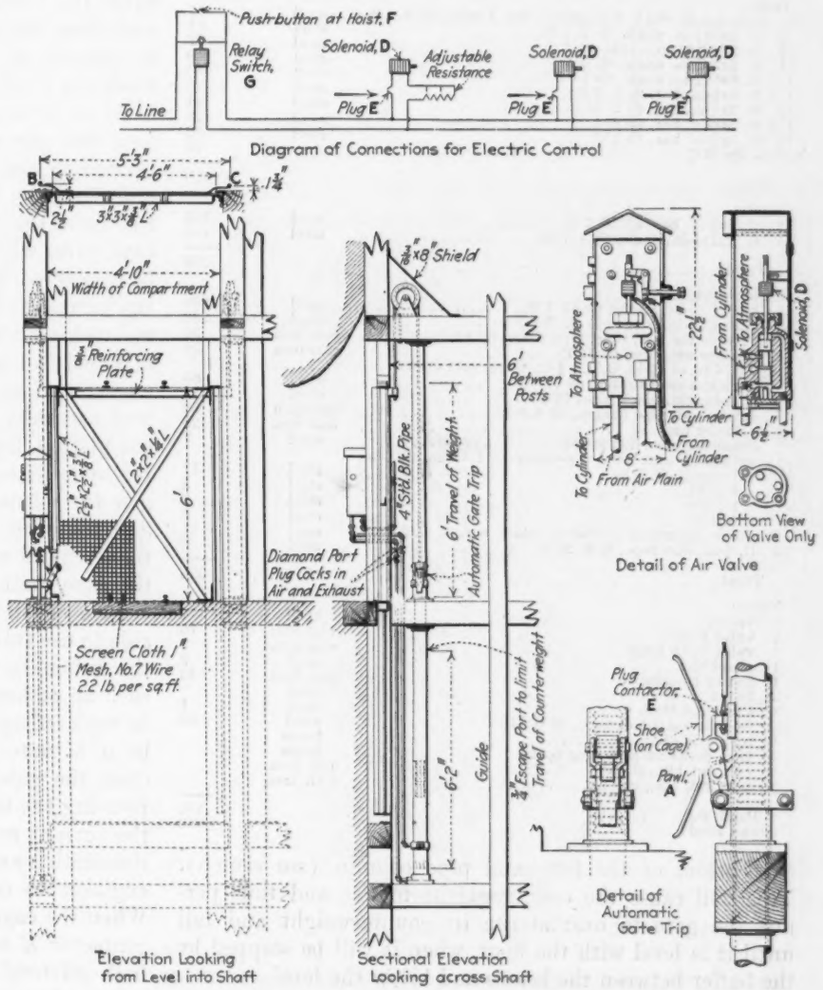
Probably the first requisite in a shaft gate is that it shall be so constructed that it can be easily and quickly opened and closed. The second requisite is that there be little or no restriction of overhead clearance, owing to the necessity of handling timbers and pipe and the difficulty of getting them on and off the cage both at the collar and at the various levels if the headroom be reduced beyond that of the regular work itself underground. A third requisite is that the initial and operating expenses be kept as low as is possible.

In its simplest form the proposed gate consists of a heavy screen of small mesh on a substantial frame working in guides between the posts of the shaft sets and overbalanced by counterweights. To clear the opening from the level into the shaft, the gate is lowered so that its top is flush with the floor of the level. There being no central rope, the entire height of the opening from the level into the shaft is thus unobstructed, and the top of the gate may be used as a continuation of the floor, so that there shall be no appreciable opening between the edge of the floor and the edge of the cage.

In order to insure a closed gate at all times when there is no cage at the landing, a device, depending upon the passage of the cage, automatically closes the gate when the cage leaves the landing. The design contemplates the use of compressed air in opening the gate only. The necessary weight of the gate to insure withstanding of severe shock may make it desirable to provide for mechanical operation. The gate proper is hung at each end of its top bar by a wire rope carried up and over a sheave and supporting on its opposite end a counterweight of a bar of iron or mild steel.

The counterweight on the right-hand side will be of a weight equal to just half of the gate proper, while the bar on the left-hand side will carry whatever excess weight may be required to insure positive action. The right-hand counterweight will move up and down inside of a pipe column, but there will be no contact or fit required at any point. The column is purely a guide to prevent any possibility of interference of the weight with the cage or any other part of the shaft. The left-hand counterweight will be fitted at its lower end with a sort of piston head which will carry a cup leather. That portion of the inclosing column that is directly opposite the gate may be made of common pipe, but the section below the level will require to be of smooth bore, so that the piston on the lower end of the counterweight may have a neat and practically air-tight fit. The use of cold-drawn seamless tubing is suggested as something that is comparatively inexpensive and yet will undoubtedly afford as accurate a bore as will be required. Near the lower end of the left-hand counterweight there must be a series of grooves, or notches, which will serve as a rack in which a pawl may engage. These notches should be turned about the periphery of the bar in order that any twist of the rope may not render them ineffective.

Attached to the left-hand inclosing column at a point slightly above the floor level will be a lever which is so pivoted that under normal conditions it will hang out into the shaft slightly. This lever will carry a pawl



DETAILS OF SEMIAUTOMATIC SAFETY GATE

*Safety engineer, Industrial Accident Commission, San Francisco.

which, when the lever is forced toward the column, will project through an opening in the side of the pipe column, and thus be thrown into contact with the counterweight itself. This lever with its pawl has been designated the "automatic gate trip." The movement of the gate trip is accomplished by means of a shoe which is attached to the side of the cage. The trip is thus actuated whenever the cage may pass it, but has no effect upon the gate itself. Assuming that the cage has come to rest at a landing and that it is desired to open the gate, a pressure on the knob, or handle, of the air valve will result in lifting the balanced piston valve so that the compressed air from the air main will be admitted through the valve and into

BILL OF MATERIAL

Quantity	Description	Material	Weight, Lb.
	Gate:		
30	sq.ft. screen cloth, 1-in. mesh, No. 7 wire, @ 2.2 lb.	steel	67
9	ft. 3x3x$\frac{1}{4}$-in. angle, @ 7.2 lb.	steel	64
13	ft. 2$\frac{1}{2}$x2$\frac{1}{2}$x$\frac{1}{4}$-in. angle, @ 5.9 lb.	steel	77
15	ft. 2x2x$\frac{1}{4}$-in. angle, @ 3.2 lb.	steel	48
0.7	ft. 6x6x$\frac{1}{4}$-in. angle, @ 14.2 lb.	steel	10
5.5	ft. 3x$\frac{1}{2}$-in. bar, @ 3.8 lb.	steel	21
17	ft. 2x$\frac{1}{2}$-in. bar, @ 2.55 lb.	steel	44
3.3	ft. 5x$\frac{1}{2}$-in. bar, @ 6.4.	steel	21
15	ft. 2x$\frac{1}{2}$-in. bar, @ 1.7	steel	26
	Rivets, @ 10%		38
	Total		416
	Guides:		
24	ft. 8x$\frac{3}{4}$-in. bar, @ 10.2 lb.	steel	245
24	ft. 2x2x$\frac{1}{4}$-in. angle, @ 4.7 lb.	steel	113
	Total		358
	Counterweights:		
1	bar of 3$\frac{1}{2}$-in. round, @ 32.7 lb.	steel	208
1	bar of 3$\frac{1}{2}$-in. round, @ 32.7 lb.	steel	258
2	sheaves for $\frac{3}{4}$-in. rope, 8-in. diam. @ 15 lb.	cast iron	30
2	sheaves supports, @ 12 lb.	cast iron	24
	7 ft. 4 in. of 4$\frac{1}{2}$-in. O.D. x $\frac{1}{4}$-in. thick, cold drawn Seamless steel tubing, @ 11.34	steel	83
22	ft. 4-in. std. black pipe, @ 10.7 lb.	steel	235
7	4x9-in. std. pipe flanges, @ 4.0 lb.	cast iron	28
1	cylinder base	cast iron	22
1	exhaust connection saddle	steel	7
1	automatic gate trip, consisting of 1 lever, @9 lb.,		
	1 clamp, @ 8 lb.	steel	17
	1 pawl	steel	2
	1 roller	steel	2
	3 pins	steel	3
2	sheave guards of 3/16x8-in. plate = 6 ft. @ 5.1 lb.	steel	31
25	ft. $\frac{3}{4}$-in. wire rope, @ 0.23 lb.	steel	6
	Total		956
	Valve:		
1	valve	steel	4
1	valve body	cast iron	16
1	valve body head	cast iron	2
1	gland nut	steel	2
1	box or housing	cast iron	43
2	levers	steel	
1	knob and stem	steel	1
28	ft. $\frac{1}{4}$-in. std. black pipe, @ 0.84 lb.	steel	24
1	rock drill oiler	brass	
2	$\frac{1}{4}$-in. diamond port plug cocks	brass	
8	$\frac{1}{4}$-in. std. blk., elbows	cast iron	
3	$\frac{1}{4}$-in. std. blk., unions	mall. iron	
	Total, say		100
	Grand total		1,830

the bottom of the left-hand pipe column (see sketch). This will cause the counterweight to rise and thus permit the gate to overbalance its counterweight and fall until it is level with the floor, when it will be stopped by the buffer between the beams and below the level.

When the gate has reached the extreme position, the counterweight will have risen to a point where the series of notches is automatically tripped, and the pawl will thus be enabled to engage with a notch; and so long as the cage remains at the landing, the counterweight will be supported by the strap and there will then be no tendency for the gate to rise above the level of the floor.

Immediately upon the cage moving away from the landing, there will be no support beyond the trip, and the downward pressure of the counterweight together with the overbalanced lever will cause the trip to drop downward and thus release the counterweight and permit it to pull the gate up to the closed position.

Owing to the speed that may be attained during the movement of the gate, a cushion below the counterweight is provided and a special type of valve required. This valve will return to its normal position immediately upon the hand being removed from the knob or handle. The normal position of the valve cuts off the air supply. The design admits of the opening of the gate at any time irrespective of the position of the cage, but to allow the gate to remain open one must keep the pressure below the counterweight.

The electric connection shown in the valve box, while not essential, may prove desirable, as it would permit the hoisting engineer to operate the gates.

The movement of the valve will be accomplished by means of a solenoid *D* which surrounds the valve stem; the core for the solenoid will be a part of the stem. Thus when the solenoid is energized the valve will be lifted, and when the solenoid is deënergized the valve will drop by gravity to its normal position. Provision may be made for hand control also.

By referring to the diagram of connections, it will be seen that one wire, say from the 110-volt circuit, will be carried to the hoisting engineer's station and be opened and closed by means of some type of push-button. From the hoist the wire will be carried out to the shaft and both wires will then go down the shaft and each gate will be connected in parallel to the two mains. In addition to the breaking of the circuit at the hoist, it will be necessary to break each branch circuit by means of a plug contactor attached to the automatic trip. When it is desired by the engineer to open the gate at, say, the third station, it is first necessary that the cage shall be at that station, thus completing the branch circuit. When this condition is realized, the engineer, upon pressing the button, will energize the solenoid at the third station. The valve will lift, and the gate will be opened as desired. The gate will then remain open, by reason of the automatic trip, until the cage shall be moved away from the landing.

Relay switch *G* is indicated in case it should be desirable to use full electric control rather than to depend upon the automatic trip for supporting the counterweight. If such an arrangement is desired, the automatic trip would be replaced by a similar lever, whose only function would be to actuate the plug contactor. When it is desired to open the gate, and if the cage is at the landing, upon pressing the button at the hoist, the solenoid is energized, the current returns through the relay switch, which closes the auxiliary circuit and thus makes it unnecessary for the engineer to continue to hold the push button in place. When the cage is moved away from the landing, the plug contactor *E* breaks the branch circuit, thus deënergizing both solenoid *D* and relay switch *C*, so that everything returns to normal and the entire mechanism is inoperative.

The section plan which shows the top of the gate indicates two different styles of guide, but it is believed that style *C* is preferable to *B*, though there may be conditions which would make the latter preferable.

Correction: "Cost of Plant per Kilowatt"—Owing to an omission in the transcription of data in the article on page 227, issue of Jan. 29, the size of the plant was incorrectly stated. The station rating should have been 3,750-kw., the units being one 1,200-kw. and three 850-kw. machines. The corrected unit cost of the entire station is $100.57 per kw. The costs of the individual equipment items are correct as published, as are also the totals.

Method of Removing Broken Ore from Flat Stopes

One of the most, if not the most, inefficient operation connected with mining on dips of 25° to 33°, says Mr. M. Weimbren, in the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa, is the removal of the broken ore from the stopes, for the reason that the work is carried out by unskilled natives whose main object is to get through the shift with as little exertion as possible, and the work is difficult to regulate and supervise when, for instance, 10 natives are shoveling near one another in the same part of a stope, it being almost impossible to place them so that they do a maximum amount of work. The result is that instead of each native lifting the rock and throwing it as far as possible, he only scrapes it along the footwall into the shovel of the native immediately below him.

To obviate this a system was introduced whereby a permanent line of chutes was laid down at a safe distance

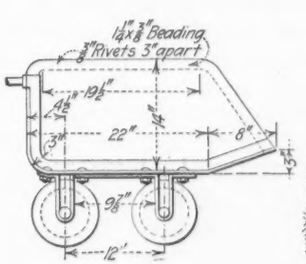


FIG. 1. DETAIL OF STOPE CAR FOR FLAT STOPES

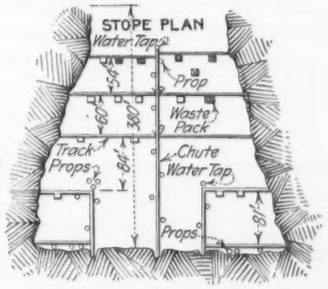


FIG. 2. STOPE PLAN SHOWING METHOD OF MINING

from the faces of the stopes; in many cases one line of chutes being sufficient for both faces. Each line of chutes was given a uniform grade, the same as the dip of the vein, so that the rocks should go from the very top of the stope down to the bottom without choking the chute or jumping out. The chutes were well anchored by putting in at every fourth or fifth section, props made of stout lagging poles to which the sections were chained.

Tracks of 1-ft. gage were then put in at approximately every 50 ft. along the dip of the stope and running horizontally from the faces to the chute. It would at first sight appear that it would be difficult to lay down a number of horizontal tracks in a stope dipping at 33°, but this by no means proved to be the case, and it was seldom that the foot wall had to be blasted to obtain a horizontal track bed.

A special type of car was designed, which was light and could be easily placed in a position of safety behind some waste pack at the end of the shift, when blasting was to be done. The car has a capacity of 5 cu.ft., and as the total height is only 1½ ft. from the rail, it can be handled very readily in most stopes. It is tipped by pulling the back of the car upward, the front wheels acting as the fulcrum. The details of construction are shown in Fig. 1.

The accompanying sketch of the stope, Fig. 2, shows clearly the system employed, especially in stopes with long backs. After the system was introduced, the number of shovelers was reduced 50%, and yet the stope was kept cleaner than it was before. A water tap at the head of the chute furnished water to assist in making the ore run on this flat incline. The barricades *A* and *B* were to protect the natives, when tipping the cars on their respective tracks, from ore passing down the chute from the tracks above. A half-section of rail (9 ft. long) is kept ready at each track, so that the rails can always be kept close up to the face. As a rule, one native shovels the rock onto the track while another loads it and wheels it to the chutes.

Summarizing, the system consists of permanent chutes and tracks running from the face to the chutes, roughly, every 50 ft. on the dip with specially designed trucks to overcome the difficulty of the small stoping widths. The advantages claimed for this system are: By having permanent chutes no time is wasted at the beginning and end of the shift in putting them up and taking them down; gravity is made to assist as much as possible in handling the ore; instead of boxes every 20 to 30 ft., they are only necessary every 60 to 70 ft.; better supervision over the natives is possible.

Watch Face as Protractor*

During my last summer's vacation in the backwoods it happened one day that I wanted to lay off approximately an angle of 60 deg. It also happened that my watch was laying on the table in my rustic quarters, and by chance I suddenly realized that its face would serve as a reasonably good protractor. The accompanying illustration shows what I mean.

At the time it struck me as rather odd that I had never before seen a "protractor" in a watch face. On my return to civilization I amused myself by asking about every other person I met if he had ever used a watch as

USING WATCH FACE AS A PROTRACTOR

a protractor or ever heard of such a thing. I kept this up for several weeks and asked scores of people—engineers and professional men—and with the exception of one young civil engineer who had used the watch face to judge roughly an angle in the field, I did not meet one man to whom the whole idea was not a sort of amusing surprise. I do not suggest for a moment that the "discovery" is of great value, but it was a source of momentary convenience to me, and perhaps it is worth passing along. With a little care it is possible to lay off any required angle with little error.

[A note on the watch face as compass appears in the *Journal* of Nov. 13, 1915, page 802.—Editor.]

*George H. Fellows in "American Machinist," Jan. 13, 1916.

Details of Milling and Smelting

Lifting a 210-Ton Converter

By E. E. Thum*

The advancement of an art usually requires heroic expedients to bridge transition periods. Twenty years ago, in the early Western copper smelteries, a 20-ton crane was strong enough to handle the small converter shells then being introduced to purify copper matte and white metal. After a few years, however, it was found economical to increase materially the size of the shells, and therewith came the necessity of installing a heavier craneway to handle them between stall and lining department. Growth still went on, until two cranes lifted one shell between them in a heavy yoke.

Twenty-foot converter shells far exceed the capacity of this combination. Fortunately, however, the lining of basic brick had proved its utility and the necessity of providing excessively heavy cranes with high headroom to transport the shells about was happily eliminated. These converters are now built in their own stalls, properly lined with magnesite brick, dried, set in operation, and with minor repairs will operate for years without disturbance.

The original 20-ft. converter was operating in the old converter department at the Great Falls plant of the Anaconda Copper Mining Co. during the 1913 reconstruction. New plans called for a number of these large shells facing the opposite way at a considerably higher elevation and at the other side of the new craneway, which, by the way, occupied practically the same space as the old. It became necessary, therefore, to take this shell, containing an excellent and very expensive basic lining which should not be disturbed, out of its old stand, transport it across and some distance down the craneway, turn it 180° about and raise it about 3 ft. into a new stall already prepared for its reception. The estimated weight of the piece was 210 tons. Commanding the area was one new 40-ton crane, busy most of the time with operating-department requirements, which received first call.

After considering various possibilities, it was decided to raise the converter clear of its trunnions, ride it on pipe rollers to the new location, turning it about en route, and then to raise it up the necessary distance to its new stall. Rolling up an incline was not done on account of the danger attendant upon any breakage in the tackle.

In the old location the shell sat so low that a large ladle-pit had been dug under it to allow it to rotate while pouring and cleaning. This pit was cribbed up solid with second-hand timbers and the shell raised clear of its rollers with hydraulic jacks. It proved to be a very slow and laborious undertaking, inasmuch as the weight was so great that it required the entire available assortment of rather low-power jacks, and the work was consequently interrupted at short intervals to catch up some short jack that had run its limit or to rush an overstrained jack to the shop for a new set of gaskets or other repairs. The rigger bossing the job at last lost patience and hooked the crane into one trunnion to "give a lift"; the net result was a broken crane hook and a ruined hoisting cable.

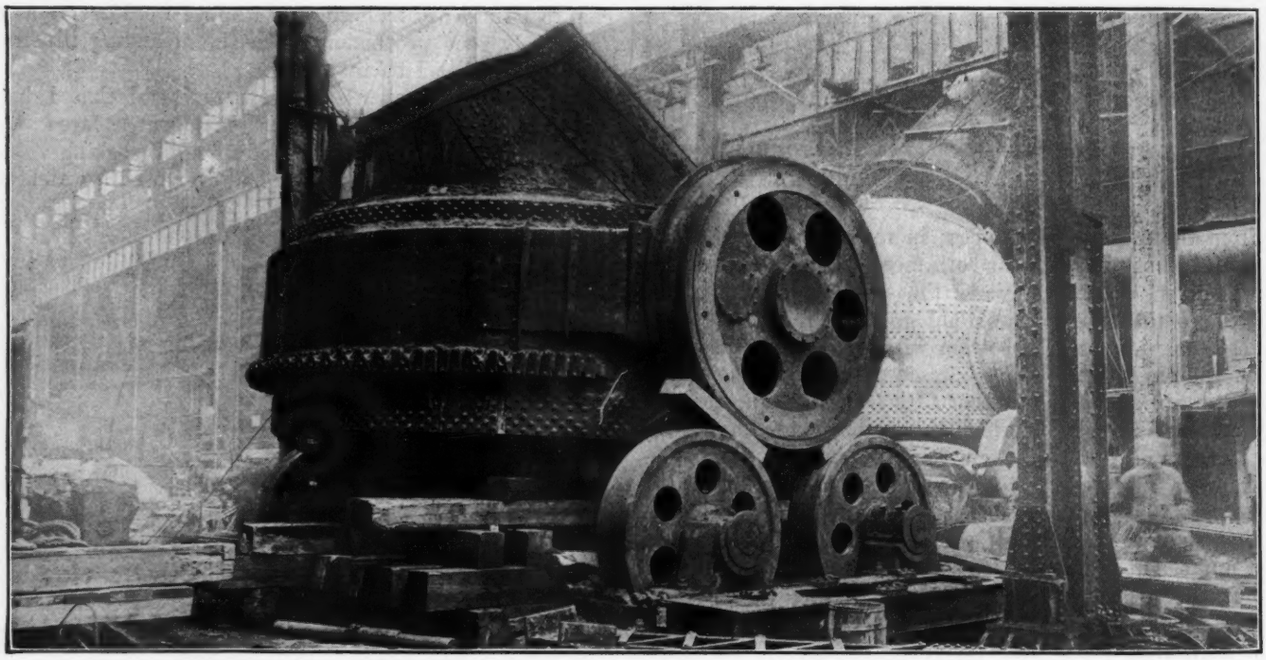


FIG. 1. THE CONVERTER SHELL RAISED TO REMOVE ROLLERS FROM BEARINGS

*University of Cincinnati, Cincinnati, Ohio.

FIG. 2. MOVING THE CONVERTER ON PIPE ROLLERS

The photograph, Fig. 1, shows the shell raised the 6 in. necessary to remove the rolls from their bearings. A mat formed of two layers of 3x12-in. planks, crossed and spiked together and sheathed below with ⅜-in. boiler plate from stock, was raised to the level of the bottom of the converter and blocked securely at a dozen points by 14x14-in. timbers cut on a bandsaw to fit snugly against the spherical bottom of the shell. The underlying crib was built smooth and solid up to within 5 in. of the mat. It was then covered with boiler plate and stock 4-in. iron pipe nested closely together between—preliminary calculations having shown them to be safe under three times the imposed load.

The shell was then lowered on the pipes, the rolls were removed from under the trunnions, and the shell was ready for lateral movement. A level runway of solid timber was built toward the new site and covered with boiler plate. A rolling hitch was taken, leading from the side of the shell, with a ⅝-in. steel cable reeved in 20-ton triple steel blocks, the line leading through steel snatch-blocks to a point under the old craneway, where the crane could give short lifts. By "cutting" the pipe rollers sharply and using quantities of grease and pulling heavily from the tackle, the shell was safely landed on the new site, properly oriented. Fig. 2 shows the shell en route. Barring the breakage of several heavy chain-slings, the transit was effected without accident.

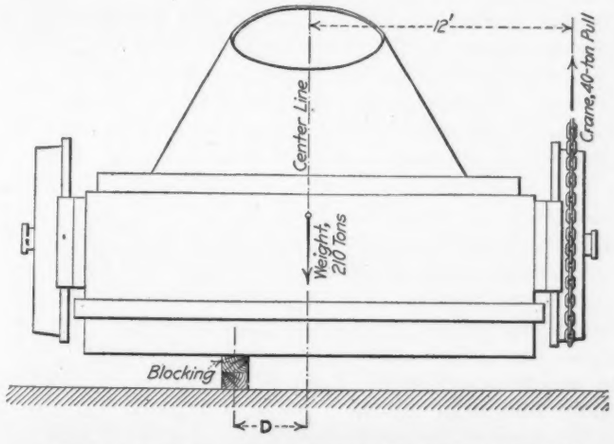


FIG. 3. LIFTING THE CONVERTER WITH AID OF BLOCKING

The shell was then jacked up a short distance and the rollers and mat removed. Experience with raising the shell from the old stall indicated the wisdom of replacing the jacks by some other arrangement for lifting the shell through the 3 ft. necessary to place it on its rollers. The following scheme was hit upon:

A sling consisting of several turns of cable was thrown around one of the trunnions for the 40-ton hook of the crane. A fulcrum was arranged at the proper distance from the center line of the load, so that the crane was not overloaded, as shown by the sketch, Fig. 3. The crane then raised its load about 6 in., and another fulcrum was blocked up to the bottom of the shell the same distance on the other side of the center line. At this point all was ready for a lift of 12 in. on the other trunnion. A succession of lifts on alternate sides "teetered" the load up 3 ft. in a few hours and at a cost only a fraction of that of the original lift with jacks. It is seen that each 12-in. lift of the crane raised the center of gravity of the converter 2¼ in.

Hendrie & Bolthoff Ore Cooler

An ore cooler embodying advantages of rapid temperature reduction and economical operation is being offered by the Hendrie & Bolthoff Manufacturing and Supply Co., of Denver. It is known as the Iron Mask ore cooler.

The cooler comprises two concentric cylinders. The outer shell is 3 ft. in diameter and 14 ft. long. The inner cylinder, or shell, is 24 in. in diameter with ¼-in. walls. Just as few rivets and bolts are used as possible, to avoid the possibility of leakage. The inner and outer cylinders are bolted together, which construction permits the removal of the inner cylinder if required. The two cylinders revolve together and the tires are split and removable, as is also the driving gear. These are clamped in place and secured by dowels. Spirally placed baffles feed the ore in between two cylinders and here it is carried up and distributed, the flights on the outer shell beginning to discharge onto the inner shell near the belt. The ore remains approximately 180° in contact with the upper surface of the inner shell. The constant removing and transferring of the ore from one point to another, bringing it in contact with fresh surfaces, increases the cooling efficiency. The flights are in short sections to avoid expansion troubles. The ore feeds evenly between the two shells and is discharged at the end of the larger cylinders.

Water is distributed on the exterior of the outer shell from an elevated water box, and is sprayed on the interior of the inner shell by means of a stationary water pipe. Owing to the fact of there being little slippage, the power required is low. The machine has been successfully introduced in Colorado and has made an excellent record, one installation having now been in operation for over two years, handling about 120 tons in 24 hr. without mechanical wear or evidence of deterioration.

Flotation Has Been Used by the Cuba Copper Co., operating the Cobre Mines, near Santiago, on its copper ore since the early part of 1914. This is one of the out-of-the-way corners in which this new art has sprung up and is being profitably used. An interesting feature is that the oil is added into the tube mill while grinding is taking place, thus giving the most thorough mixing possible.

Company Reports

Annual Report Nevada Wonder

The annual report of the Nevada Wonder Mining Co., Wonder, Nev., for the year ended Sept. 30, 1915, shows a profit of $327,557 and dividend payments of $140,807. Cash on hand at the end of the year amounted to $10,273. The total value of 58,124 tons of ore mined and treated was $812,118, of which $764,312, or 94.11%, was recovered. The production of metal amounted to 9,801 oz. of gold and 1,123,398 oz. of silver. Development work consisted of 6,053 ft. of drifts, crosscuts and raises and 171 ft. of shaft-sinking. The mine produced 58,124 tons of mill ore, 37 tons of second-class ore, 16,675 tons of waste hoisted and 2,971 tons of waste for filling. The following table gives a comparison of mine costs for the two years:

	1913-14	1914-15
Direct cost per ton of ore hoisted	$3.78	$3.33
Indirect cost per ton of ore hoisted	.87	.83
Total operating cost per ton of ore hoisted	$4.65	$4.16
Total operating cost per ton of ore and waste hoisted	3.01	3.26
Total operating cost per ton of ore and waste broken	2.85	3.13
Transportation of ore to mill per ton of ore hoisted	.05	.035
Subshaft sinking and station cutting per ton of ore hoisted	.55	.18
Subshaft sinking, cost per foot	.....	35.07
Average cost per foot of drifting, cross-cutting, raising and winze-sinking	6.44	7.70

The mill treated 58,124 tons, or an average of 159.2 tons a day. The stamps crushed 15.92 tons per day of 24 hr., but based on actual operating time, the tonnage was at the rate of 18.01 tons per stamp per day. The following table gives a summary of mining and milling costs and profit per ton of ore for the last two years:

	1913-14	1914-15
Mining cost per ton of ore	$4.70	$4.11
Subshaft-sinking and station-cutting per ton of ore	.55	.80
Enlarging shaft, per ton of ore	.04	
Milling, per ton of ore	3.37	2.81
Marketing products, per ton of ore	.28	.27
Total cost per ton	$8.94	$7.45
Average value per ton of ore	$15.52	$13.97
Loss in tailings per ton of ore	1.06	.82
Recovery per ton	$14.46	$13.15
Less total cost per ton	8.94	7.45
Profit per ton of ore mined and milled	$5.52	$5.70

Dominion Iron and Steel Co.

A preliminary report made by the directors of the Dominion Iron and Steel Co. says that the improvements made at the plant at Sydney, Cape Breton, in 1915, included installing a plant for the recovery of benzol and other products at its byproduct coke plant; also the erection of a 16-in. two-high rolling mill. Additional equipment was provided for the wire and nail shops to permit the drawing of finer wires and to enlarge the capacity of the nail and fence departments. Three steamers were purchased by a subsidiary company to provide tonnage suitable for growing export trade. The statement further says:

The output of the various forms of iron and steel in the year 1915 was approximately as follows: Pig iron, 309,800 tons; steel ingots, 349,000 tons; blooms, billets and slabs for sale, 119,999 tons; rails, 57,500 tons; wire rods, 73,500 tons; merchant bars, 78,000 tons; wire and products of wire, 34,000 tons.

The greater part of the pig iron produced was used in the manufacture of steel, but during the year about 13,000 tons was shipped to foundries in Canada. The steel ingots were converted into the other forms of steel, and practically all was sent to market during the year except what may be on hand awaiting shipment. It is interesting to note how the character of the output has changed with the demands of a changing market. In the first place the basic products, pig iron and steel ingots, have increased 70% and 47% respectively. Sales of blooms, billets and slabs, including steel required to produce shell blanks, increased fivefold; output and disposal of wire rods increased 95%; wire and products of wire, such as nails, increased 30%. On the other hand, there was a decrease of 52% in the output of rails, and the quantity of merchant bars turned out in 1915 was only about half the quantity shown in the previous year's returns. The distribution between deliveries in Canada and exports expresses in a very striking way how entirely the character of the company's business has changed. In the year 1914, 67% of the sales of the steel was for consumption in Canada and only 33% was for export. In the year 1915, 66% was in the form of materials to be exported and only 34% was for home consumption.

Orders now booked cover the output of the mills for months ahead.

Sulphide Corporation Mills Make High Recovery

At the 19th annual meeting in London of the Sulphide Corporation, Ltd., the chairman reported for the second half of the fiscal year—January to June, 1915—the largest output ever recorded in a half-yearly period, namely, 126,758 tons of ore yielding 23,722 tons of lead concentrates and 37,488 tons of zinc concentrates. This output was possible because, some of the mines at Broken Hill having closed down, there was a better supply of labor than heretofore.

The improvement in the labor position had a favorable influence on costs, which were lower than those of the previous year, both for mining and milling. In the cost of mining and development there was a reduction of 1s. 6d. ($0.36) per ton, due partly to less expenditure on development work, the year's cost being 17.9s. ($4.36) per ton against 19.4s. ($4.72) per ton in the previous year. The milling cost in the lead section was 6s. ($1.46) per ton, as compared with 6.7s. ($1.63) per ton in the previous year; in the deleading plant, 3.2s. ($0.78), against 3.4s. ($0.83); in the zinc section the costs were 5.8s. ($1.41) per ton, against 6.6s. ($1.61), the work in this section being favorably affected by further improvements in the Minerals Separation process.

The recoveries from plants were the best yet made. The combined recoveries from the lead and zinc mills and the deleading plant reached the unusual figures of 90.6% of the silver, 93.7% of the lead, and 92.8% of the zinc in the crude ore. The new slime-treatment plant has completed, and there are on the dumps 200,000 tons of slimes from which profit will be derived for several years as soon as a new contract can be made for the disposal of the zinc-lead products.

The whole of the company's output of lead concentrates was smelted to bullion at its Cockle Creek smelting works,

without the interruption that occurred in the disposal of the zinc concentrates owing to the smelting contract being terminated by the war. A comparatively small amount of the zinc concentrates was taken by the Central Zinc Co., at Seaton Carew, England, in which the Sulphide Corporation has an interest. A new furnace is now approaching completion at Seaton Carew that will enable the Central Zinc Co.'s works to deal with about one-quarter of the Sulphide Corporation's output. This works will doubtless be extended, but whether it will be increased so as to deal with the whole production of the Sulphide Corporation remains an open question. The Corporation has an option to purchase the Central Zinc Co.'s works and other assets for £150,000, but has not yet exercised it. The advantage of owning its own smelting works was demonstrated by the Cockle Creek plant, which was able to treat the Corporation's output of lead concentrates and permitted the other lead departments to operate without interruption.

Report of Coniagas in 1915

The Coniagas Mines, St. Catharines, Ont., for 1915 reports a production of 2,002,053 oz. of silver shipped, of which 1,903,462 oz. was paid for by the smelters. There was 274 tons of mine ore shipped and the mill treated 55,437 tons of ore. This work was accomplished with the following operating force averaging 141.29 men per day:

Mines, office and supervision	9.16
Camps and buildings	4.17
Maintenance of buildings	0.78
Camp expense	3.84
Lands and roads	2.54
Mining	87.38
Mining maintenance	4.76
Drills, tools, hardware	1.00
Mining contracts	6.42
Fuel, oil and waste	0 82
Milling	14 14
Milling maintenance	4 84
Loading ore	0 46
Sampling	0 98
Total	141.29

The mill treated 55,437 tons, or an average of 3.02 tons per stamp in 24 hr. at 98.83% of the possible running time. Mill heads averaged 23 oz. per ton, 473.9 tons of concentrates produced averaged 2,174.6 oz. per ton and 133.2 tons of low-grade slimes ran 233.3 oz. per ton. The tailings averaged 3.94 oz. silver. Shipments from the mine have aggregated over 22,000,000 oz. of silver as shown by the following table:

TOTAL SHIPMENTS FROM THE MINE

Year Nov. 1 Oct. 31	Mine Ore Tons	Mine Ore Ounces	Concentrates Tons	Concentrates Ounces	Total Tons	Total Ounces
1905- 6	289 0	657,513 00	.....	.....	289.0	657,513.00
1906- 7	2655 0	1,341,372 00	.....	.....	2655 0	1,341,372 00
1907- 8	Mine ore and concentrates				627.5	1,457,240 00
1908- 9	350 0	807,313 00	426 0	599,975.00	776.0	1,407,288.00
1909-10	330.1	979,630 00	645.5	949,901 00	975.6	1,929,531 00
1910-11	619.1	2,142,961.71	1418.4	1,646,312.20	2037.5	3,789,273.91
1911-12	650.0	1,944,212.80	1287.5	1,564,164.47	1937.5	3,508,377.27
1912-13	735.8	2,249,394.32	1034.3	1,323,004.56	1770.1	3,572,398.88
1913-14	492.9	1,451,522.27	748.2	1,045,872.41	1241.1	2,497,394.68
1914-15	274.0	940,432.59	629.7	1,061,620.91	903.7	2,002,053.50
	6395 9	12,514,351.69	6189.6*	8,190,850.55	13,213.0	22,162,442.24

* Ore milled to date 337,564 tons.

Ore reserves are estimated to contain about 10,000,000 oz. of silver after allowing for a 20% possible overestimation. It is estimated that enough ore is broken in mine and on surface dumps to keep the mill running at its present capacity for about two years.

Based on the actual hours the machine drills were working, the mine reports show an average of 3.89 ft. drilled per hr. compared with 3.18 ft. for the previous year.

Kerr Lake

The Kerr Lake Mining Co., Cobalt, Ont., reports a profit of $550,774 for the year ended Aug. 31, 1915. Dividends aggregating $620,000 were paid. The gross production of silver from all ores was 2,036,962 oz., of which 1,198,557 was produced from shipping ore and the remainder from low-grade ore milled. The actual gross shipments for the year amounted to 1,992,065 oz., and the smelter settlements aggregated 1,777,122 oz. of silver. The cost of production per ounce is stated to have been 21.45c., made up of mining cost and development, 9.67c.; shipment and treatment charges, 11.09c.; administration and general, 0.69c. per oz.

All rock hoisted from the mine amounted to 47,436 tons, of which 38,286 tons was ore and 9,150 tons was waste. Of the ore 17,049 tons was discarded as waste from the bumping table, leaving a sorted product consisting of 20,836 tons of mill ore and 401 tons of first- and second-grade sacking ore. Based upon all rock hoisted, the mining and development cost was $4.15 per ton. The ore reserves are estimated to contain 4,172,400 oz. of silver. Included in this estimate are 54,830 tons of mill ore estimated to contain 29.3 oz. silver per ton.

Camp Bird Production in 1915

The Camp Bird Mine, Ouray, Colo., reports a production of 32,959 tons of ore during the year ended June 30, 1915. The value of the metallic contents recovered from this ore was $952,288, consisting of: Gold, $873,-717; silver, $58,015; lead, $11,191; copper, $9,365.

The average value recovered was $29.47 per ton. The profit on this ore was $583,700 exclusive of depreciation of equipment. Exclusive of depreciation the cost was $9.82 per ton, and there was also $1.60 per ton expended for development work. Of the total value of metals extracted 58.48% was saved by amalgamation, 36.59% by concentration and 4.93% by cyanidation.

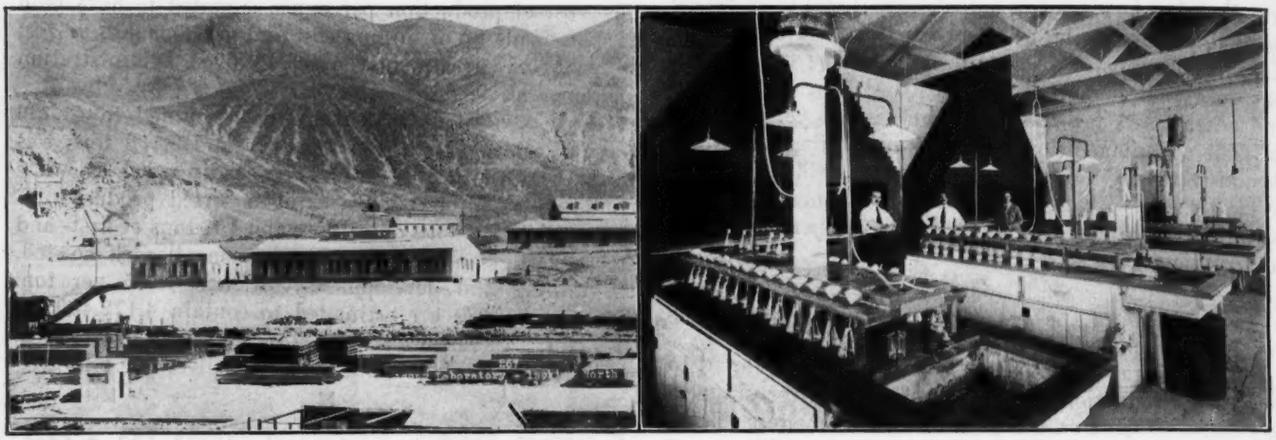
Ore reserves estimates show 14,800 tons of broken ore and 1,100 tons of unbroken ore, which is expected to yield $275,000.

Davis-Daly Copper Co. Report

The report of the Davis-Daly Copper Co., Butte, Mont., for the year ended June 30, 1915, shows charges over income amounting to $180,043. The shaft at the Colorado mine, begun in May, 1914, was completed at a depth of 2,542 ft., and development is proceeding at the 2,500-ft. level. The 1,700-ft. level was connected with the Moonlight mine of the Anaconda Copper Mining Co., and arrangements have been made to connect the 2,500-ft. level with the same mine. The lowest-level openings are exceedingly hot, and these ventilation crosscuts are expected to relieve the situation.

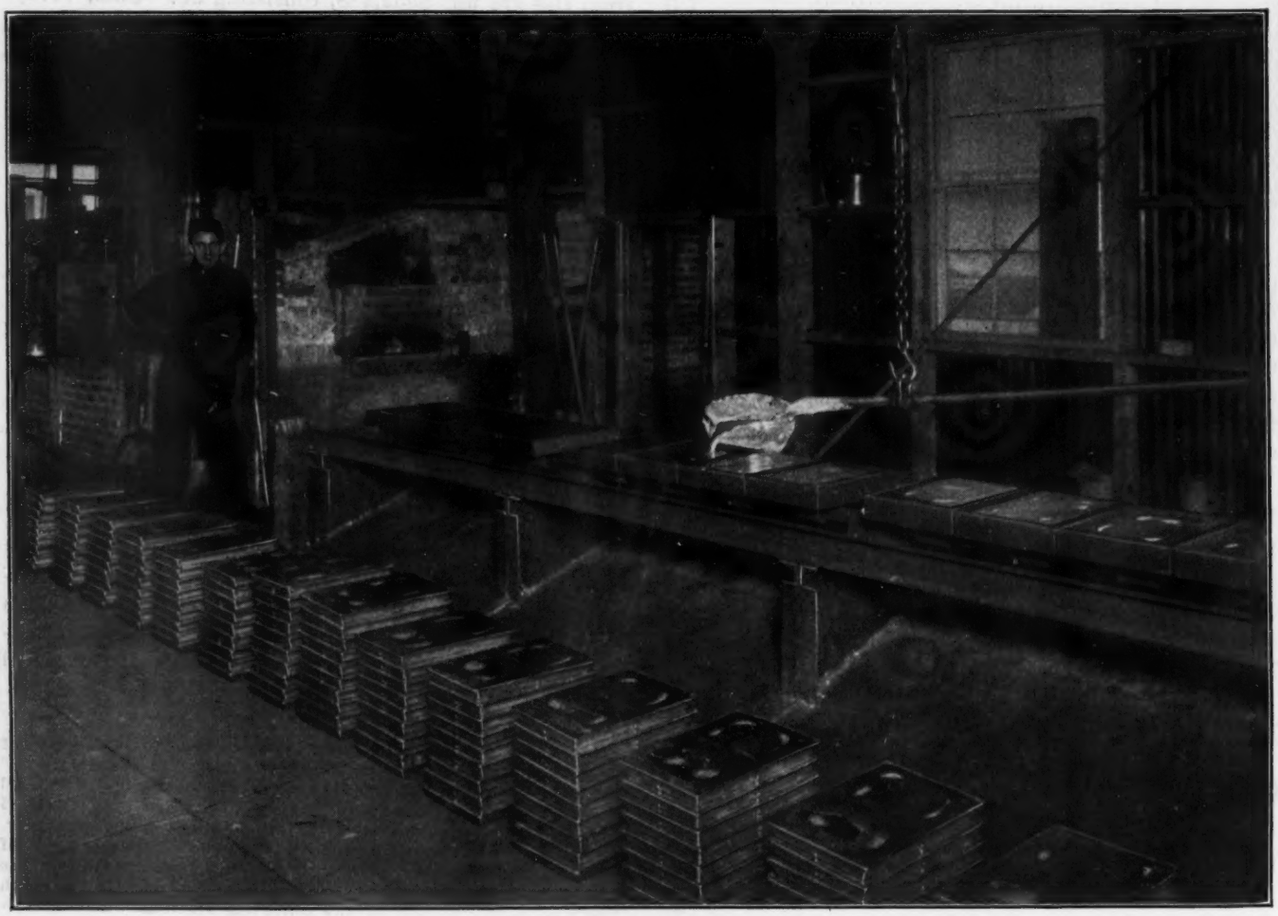
Canadian-Klondyke Mining Co., owing to a series of unfortunate accidents in 1914 and 1915, was "in the doldrums" financially. The net profits for 1914, according to Lord Brabourne of the Granville Mining Co., were only $147,085 and for 1915 only slightly greater than the preceding year. In 1915, besides having one of the large dredges out of commission most of the season through overturning, there was another accident to the same dredge, a break in the ditch line and a fire at one of the pumping stations. The nonrecurrence of this chapter of accidents, Lord Brabourne said, should permit Canadian-Klondyke to realize a net profit of between $750,000 and $1,000,000 during the current year.

Photographs from the Field

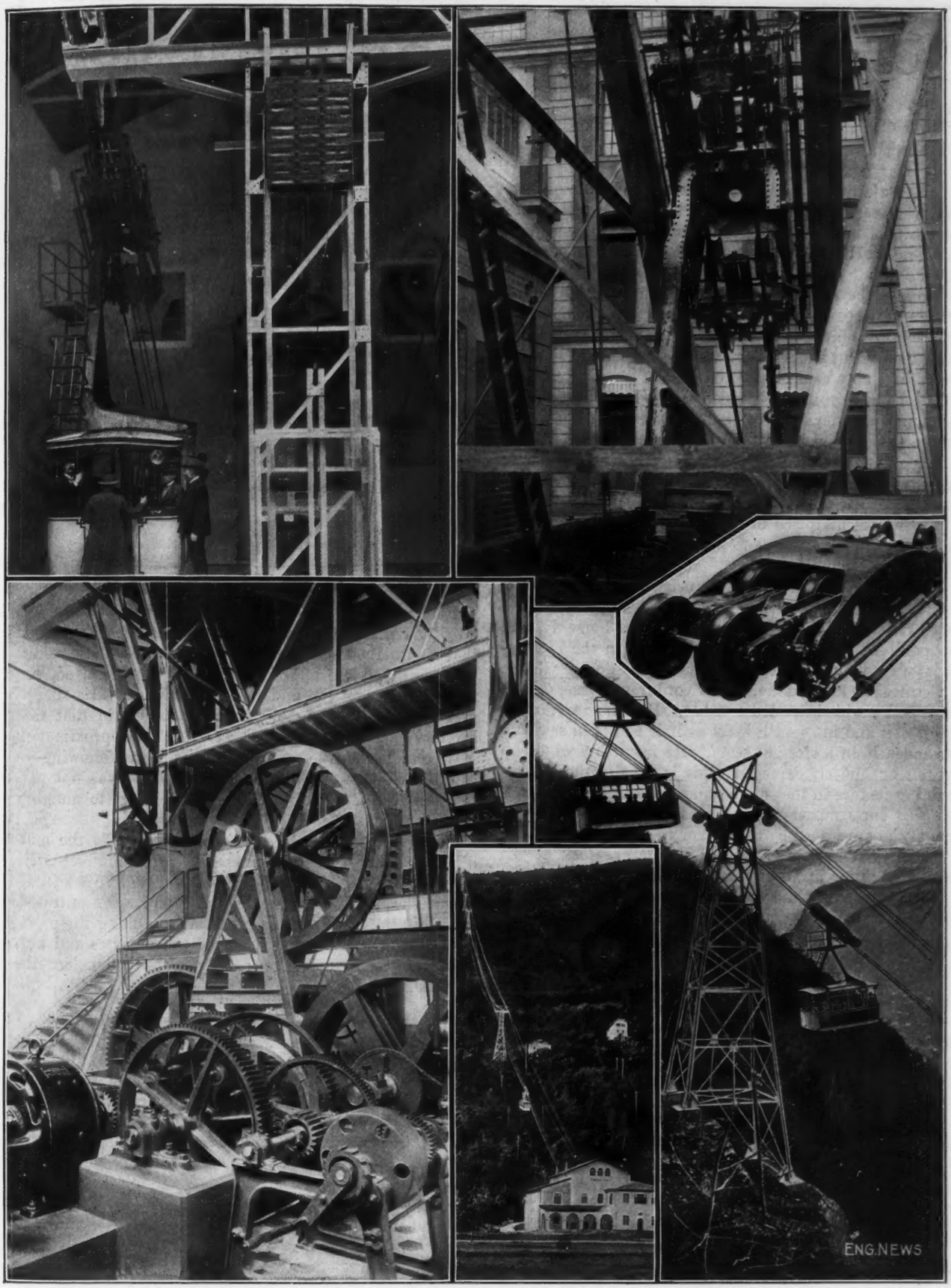


TWO VIEWS OF THE LABORATORY OF THE CHILE COPPER CO. AT CHUQUICAMATA, CHILE

A large number of samples are handled daily and a separate crushing plant is provided. This is shown at the left of the main building. At the right are workmen's quarters and the roof of the company store



REMELTING FURNACE OF THE ANACONDA COPPER CO.'S ZINC PLANT AT ANACONDA, MONT.



PASSENGER CABLEWAY AT THE WETTERHORN AND BAUERKOHLERN, SWITZERLAND, SHOWING THE MECHANISM OF A NOVEL SYSTEM OF TRAVEL TO ALPINE PEAKS, THE APPROACH TO WHICH IS TOO STEEP FOR RAILWAY TRANSPORTATION

Correspondence and Discussion

The Mining Engineer

It is not a little remarkable that the profession of Mining Engineer has received so little attention from the professional humorist. The chemist is always considered fair game. He is usually typified by an untidy stooping figure, with long hair and beard and an overdue bath, surrounded by an incongruous assortment of apparatus, and an atmosphere of curved lines supposed to represent the evil savor arising from his operations. To the lay mind the pursuit of chemistry and the emission of stenches are indissolubly associated.

The banker, rotund of waistcoat and scornful of demeanor, is another familiar figure, and so with the artist, the poet, the doctor and many others.

When the Mining Engineer comes into his own, and takes the place in the eyes of the world to which the importance of his work entitles him, it is inevitable that he will also take his place in the comic supplements. It is interesting to speculate as to what will be his incarnation under these circumstances.

In magazine fiction he appears usually as a tall, athletic individual with hypertrophied jaw bones and lean as a fence rail. He is as destitute of fear as a horse-fly, and as persistent. He is becomingly attired (in the illustrations) in a flannel shirt which sets off his fine shoulders, a picturesque knotted tie, smart corduroy trousers, high boots and a wide-brimmed felt hat. He wears a revolver in his belt and his mouth looks as if it had been sewn up permanently in a straight seam. He inevitably winds up by getting himself damaged (this is usually the one redeeming feature in the story) and then married. We confess that our sympathy always goes out to the other characters who are forced by the author to associate with him.

Turning from fiction to real life let us look at the mining engineer in his natural habitat, underground. Or rather let us look at the various aspects of him which conceal rather than reveal the man within. Let us take for our own example the ambitious junior. Will it be in him that the comic artist will find his joy? The successful and mature engineer wears clothes like ordinary people and lacks the element of the picturesque.

Our type, then, as we find it in the headings and drifts is an individual of the male sex clad in overalls of an incredible degree of dirtiness, with a complexion to match. Unless the rules of the mine forbid it (and even this reservation cannot be taken as of universal application) he smokes a pipe whose external appearance is entirely in keeping with its immediate surroundings. He delights in risking his neck by utilizing the hoisting equipment in every conceivable way except sitting in it in the manner intended by the designer, who has labored to render it as safe as human contrivances can be made. His talk is of feet drilled and of rock broken and he is always convinced that the particular part of the workings confided to his care is the "meanest rock in the mine, sir, hard as h——l to drill and 'll come down on your head every five minutes if you don't watch it all the time. The steel's rotten, and the fellows in the machine shop don't half look after the machines." And so forth and so forth. But the work goes on just the same.

In the majority of cases he manages to be on terms of cheerful comradeship with his men, without the gang losing cohesion and discipline. He sits at the feet of grizzled timber bosses and foremen who were toiling underground when he was squalling on a blanket and absorbs and lays away their wisdom. He regards the superintendent with good-natured tolerance as one who has been too long out of touch with the practical problems of underground work to be taken seriously. And if he doesn't tempt fate once too often he develops into an assistant superintendent and wears his good clothes in the office and changes ostentatiously into overalls for his periodic trips below.

No, we don't think this aspect of him will find its way into the comic supplements. It doesn't seem to belong there.

PHILOSOPHER.

New York, N. Y., Feb. 5, 1916.

Concentration Formulas

Replying to J. E. Clennell's letter in the *Journal* of Jan. 1, I must admit that his formulas are correct and that the method used by me was erroneous. My results being rather close approximations, I was deceived, not fully considering the underlying principles. His simplified formula is preferable, in my opinion, to that first given. To show how close the arithmetical approximation may come to the true result, I will quote the following—a case of lead concentration where the work was not particularly brilliant. Even figures are given to simplify matters.

The heads assayed 6% Pb, the tailings 2%, the middlings 3% and the concentrates 40%. The products were 10% of concentrates, 20% of middlings and 70% of tailings. The middlings were reground and reconcentrated. What did these add to the concentrates, making the previous assumptions that the values of concentrates and tailings remained unchanged? By substitution in the formula,

$$X = \frac{100\,(h - t)}{C - t} = \frac{100\,(6 - 2)}{40 - 2} = 10.52$$

By the arithmetical method we would say that $20\,(0.03 - 0.02) = 0.2$ ton of lead was added to concentrates, or $0.2 \div 0.40 = 0.5$ ton of concentrates. This added to the original 10 tons of concentrates would give 10.50 tons against 10.52 by the formula—a difference of only 40 lb. of lead ore in 10.5 tons, an approximation here close enough for practical purposes. But if I should attempt in this case, as in my communication of Nov. 27, to calculate the increased tonnage produced by the increased percentage saved, the error would have been greater. That method, as Mr. Clennell has said, is unsound in principle. I have to thank Mr. Clennell for the very pleasant manner in which he has set me right.

Patton, Calif., Jan. 5, 1916. LOUIS JANIN, JR.

Dredging in Straits of Magellan

Gold production in the Straits of Magellan has declined greatly during the last five years, and out of a total number of 15 dredges erected in Tierra del Fuego, one only has worked intermittently during the last three years, according to T. C. Earl, in the London *Mining Journal* of Dec. 18, 1915. The one active dredge, belonging to the Rio del Oro company, has been operating on Baquedano Creek. The Queen company's dredge at San Antonio was being dismantled for removal to the Loreto River, near Punta Arenas, on the mainland to the west of Magellan Straits.

Among the companies that have ceased operations for various reasons may be mentioned Compañia Aurifera Lennox, Lavaderos de Oro de Tierra del Fuego, Slogget Bay Dredging Co., Sociedad Aurifera Loreto, Gran Compañia Aurifera de Magallanes, Compañia Aurifera de Rio Rosario, Rio Rusphen, Rio Progreso, Rio Perez, Sutphen Lavaderos de Oro and others.

New Zealanders Installed First Machinery

The first machinery installed in Tierra del Fuego for the extraction of gold from auriferous sand was a hydraulic elevator worked by some New Zealanders in the Santa Maria River and resulted in failure. The most extensive area of known auriferous country is confined to the northwestern portion of the island in the region of the Rivers Oscar, Oro and Verde, while farther south is the Santa Maria and Rosario; mining on the Atlantic side is confined to desultory work on the black sands of Paramo beach. In the Santa Maria valley, north of Cape Boqueron, a ground-sluicing claim is now being operated by a Chilean who is said to clean up about 40 grams of gold per day. This is the largest sluicing plant on the island and employs five to seven men daily; most of the time is spent in removing large stones and shifting gear, the gravels being very shallow and rough, with considerable overburden in places.

The fluvial arteries of northern Tierra del Fuego are important and drain a large extent of gold-bearing country, but at present alluvial gold mining is confined principally to sluicing parties of Serbians, Austrians and Chilenos, who work the small gullies in a primitive fashion by hand. Most of the tributaries of the Oro, Verde and Oscar have been "cleaned out" by diggers and were abandoned years ago, when "the cream" was skimmed. The richest creeks are probably the Roux, Lafayette and the Baquedano, which have been systematically worked in their main beds from the sources to the confluence with the Verde and Oro Rivers respectively.

In several small tributaries of the Oro and Verde Rivers, the gold value has been as high as 4s. per cu.yd., but 10d. per yd. would be nearer the average value; in the deeper main river channels from 5 to 8d. per cu.yd. will probably be found. In the absence of authentic figures it is difficult to give reliable data as to treatment costs, but in some instances they ranged from 3 to 5d. per cu.yd. There is little doubt that the generally high working costs prevailing in Tierra del Fuego have so far prevented successful mining by bucket dredges. Dredgemen had to be imported and passage money paid, combined with ration allowance while under engagement. High cost of local supplies, with the additional disadvantage of great distance from foundries and facilities for heavy repairs, as well as a short working season, are factors against probable handling of the low-grade gravels of the Magellanes.

It is significant that three different types of dredge under company administration have failed to extract gold profitably from the deeper auriferous deposits of Tierra del Fuego, and, as before stated, the Rio del Oro dredge is the only one now working. This is a New Zealand dredge of 6-cu.ft. capacity, erected on the Oro flat below the Baquedano in 1905. An American sluice-box dredge (worked by spuds) on the same river failed, as also three Dutch-designed dredges of 7-cu.ft. capacity. In Mr. Earl's opinion more solidly constructed dredges would have been a success in this river, as payable gold has been proved in the upper reaches for some miles above Lafayette Creek; the amount of gravel treated and the hours worked by the machines were not up to expectation. Salting has also contributed largely to the wrecking of other dredging enterprises in this district.

Peat Used as Fuel on the Dredges

It was on this field that peat was first used for developing power for steam dredges, according to Mr. Earl. In the first stages coal was used, but was found much too expensive. The potential energy locked up in the extensive peat deposits of the Oro, Oscar and San Antonio valleys are enormous, but until the last stages of dredge mining in the island were reached, about the year 1909, little advantage was taken of this abundant and economical fuel lying close at hand. Since 1909 peat has been the only fuel used on this field.

The length of the dredging seasons varies from seven to nine months, according to locality; much depends on the altitude, also on the variable nature of the winters. The climate is severe but healthy. It is a land of perpetual tempest and in perfect accord with the dreary aspect of the bleak, treeless wastes of the northern extremity of the island. On the Punta Arenas side of the straits the shelter of the cordillera tends to lessen the severity of the cold during the worst months of the year—June, July and August—and mining operations may be carried on over a longer period than in Tierra del Fuego. Generally speaking, transport is expensive, as machinery or supplies, in addition to ocean freight, are again transported by small craft from Punta Arenas to Porvenir, whence they are loaded into carts and hauled by road over the mountains. The apathetic attitude of the Chilean government is not conducive to the investigating of the country by prospectors or the locating of large alluvial tracts by companies. The limit of claims allowed to each applicant—only three pertenencias of five hectares each—is much too small an area to give returns on large-scale investments.

Chino Copper Co.'s Report

The report of the Chino Copper Co. for the last quarter of 1915 shows a production of 19,560,245 lb. of copper—6,319,194 lb. in October, 6,939,006 lb. in November and 6,302,045 lb. in December. Total ore treated was 691,200 tons, an average of 7,513 tons per day. Average copper content was 2.11%, and average extraction was 66.92%, or 28.30 lb. of copper per ton.

The cost of net copper was 7.2c. per lb., after allowing for smelter deductions and crediting all miscellaneous

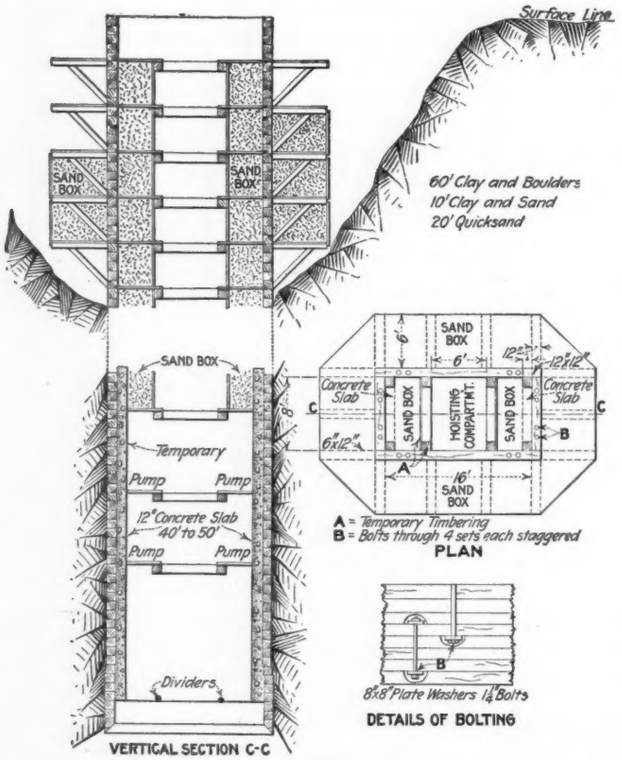
income. Earnings are based on 20.476c. per lb. for copper. Copper unsold and in transit is carried at 13.5c. per lb. The dividend rate was raised to $1 per share.

Total net profit was $2,461,716; dividends paid, $869,980, leaving a net surplus of $1,591,736. The total copper content of concentrates produced during 1915 was 68,293,893 lb.

Method of Drop-Shaft Sinking on Cuyuna Range

BRAINERD CORRESPONDENCE

Two timber drop shafts have been sunk on the South Range of the Cuyuna iron-ore district, central Minnesota, each more than 90 ft. through water-bearing glacial material, in which features that are new to such work were successfully carried out, and it is the intention to mention here these innovations only, rather than to describe the operation at length. One of these is the Wilcox shaft of the Canadian-Cuyuna Ore Co., 8 mi.



DETAIL OF DROP SHAFT

northeast of Brainerd, and the other is on the property of the Brainerd-Cuyuna Mining Co., within 1 mi. of the business center of Brainerd.

By reference to the vertical section it will be noticed that a large-sized pit surrounds the shaft. This is a deviation from past practice in the district and has been a large factor in the successful completion of the work. Heretofore it has been the general custom to fill in around the shaft, but no important gain is made by so doing. On the other hand, a pit 35 to 40 ft. in depth decreases very materially the friction against the shaft. At the inauguration of the work the pit is dug about 15 ft. deep, and the remaining depth of 20 to 25 ft. is obtained as the loose sand flows into the bottom of the shaft and the ground around the shaft caves.

The problem of getting sufficient weight on the shaft was solved by putting large sand boxes on the outside of the shaft in the pit or crater that surrounded it. By means of these outside sand boxes about 18 tons' weight per vertical foot was added to the shaft, and it was largely by the use of this additional weight that rapid progress was made. Besides providing extra weight, these exterior sand boxes supplied an easy means of shifting the weight on the shaft and thus keeping it plumb. As each sand box came into close proximity to the bottom of the pit, it was emptied and removed. Near the surface the shaft is held nearly perpendicular by excavating uniformly under the shoe and by digging under the high side when the movement of material outside the shaft has caused it to tilt out of plumb. But at greater depth this system has to be aided by the use of extra weight on the high side of the shaft.

SAND RUSHES COPED WITH BY CONCRETE REINFORCING

Rushes of sand and water often filled the shaft to a depth of 15 ft. or more, and usually at such times the shaft was thrown out of the perpendicular by several inches. In fact these rushes, or "boils," usually bowed the shaft or put a kink in it. A series of rushes so distorts many shafts of this type that they become useless except as exploratory shafts. To overcome this feature some means was sought to distribute the stresses developed, and a concrete slab along the end walls of the shaft was tried out with success in both instances. Upon final completion of the shaft this monolith of concrete can be either removed or left in place, depending on whether the extra space is desired inside the shaft.

At the shafts of the Brainerd-Cuyuna Mining Co. the material encountered was about 60 ft. of clay and boulders, 10 ft. of clay and sand and 20 ft. of quicksand. Some water was encountered at about 15 ft., but only a small quantity until at a depth of over 60 ft. A maximum of 800 gal. of water per min. was handled through the quicksand area.

Both shafts were designed for three compartments, two skip roads and a ladder and pipe way, and the requirements were for inside dimensions of 6x14 ft. In order to have ample leeway the drop shaft through the overburden was made 8x16 ft. Both shafts were sunk near enough to the perpendicular so that they can be used as permanent hoisting shafts. The arrangement of compartments shown in the sketches is temporary for the purpose of sinking only. After the shaft is ledged the temporary dividers are removed and the permanent ones put in. The dividers in the working space below the pumps interfere somewhat with the workmen, and to avoid their use, heavier shaft timbers could be used to advantage for the first few feet of the shaft.

The writer is indebted to D. C. Peacock, of Brainerd, the consulting engineer under whose general supervision both shafts were sunk, for the details of this work.

Gasoline Production in the United States is reported by the Bureau of Census for comparative purposes at 5-year intervals as follows: In 1914, gasoline from crude petroleum, 23,908,242 bbl. (50 gal.); gasoline from natural gas (casing-head gasoline), 853,053 bbl.; total, 24,711,565 bbl. In 1909 the total output of naphthas and lighter products was 10,806,550 bbl. No segregation of light oils was shown for 1909, but the totals indicate an increase of over 170% in the 5-year period.

Editorials

Speaking of Fleshpots

For many years the men who are most active in the mining industry of the United States have been agitating a reform of the archaic mining law of 1872, which everybody knows to have been prolific in inciting litigation, and many have suspected it to be a check on mine development on that account. The greatest evils of the existing law are its granting of extralateral rights and its making of discovery a prerequisite to valid location. The law of 1872 had been enacted but a few years before litigation (notably the Richmond-Eureka case) arose from the extralateral provisions, and that kind of litigation has been going on ever since for the simple reason that the conception and terms of the law do not fit the conditions of the occurrence of ore deposits. About the same thing is true also of the provision respecting discovery. There are many classes of ore deposits, such as the "deep leads" of California, the blanket veins of numerous districts and blind lodes generally, that cannot be discovered until costly exploratory work has been prosecuted.

The recognition of these conditions is so general that mining men of all classes—prospectors, developers, operators and capitalists—have been all but unanimous in the demand that these evils of the existing law be abolished. Such dissent as there is may be classified as coming from lawyers who are averse to a reduction of the opportunities for litigation, from a few lawyers and other persons who adhere academically to the theory that anyone that finds ore ought to be able to follow it wherever it goes, and from persons who are apprehensive that existing titles might be jeopardized. To their credit let it be said that the majority of lawyers and mining experts who have profited most from the costly litigation that has arisen out of the apex law are earnestly in favor of its cancellation. To the owners of mining property who are apprehensive, let it be said that no new law may be retroactive, that any alteration of the mining law of the United States can apply only to those lands that have not yet been taken up.

Besides the extralateral and discovery features, however, there are numerous other things in the law of 1872 that are bad. Among these are uncertain and antiquated provisions respecting the location of placer claims and millsites, the conflicting rights respecting placer claims and lode claims, the conflicting rights between lode claims and tunnel sites, the provision respecting annual assessment work on claims that has long been farcical, the evils of claim-hogging and location by proxy. The existing law is, moreover, highly faulty in such relatively simple things as the provisions for recording claims and in its lack of provision for appeals to the courts from decisions of administrative officers.

As to how these and other faults should be corrected in a new law, there is not the same unanimity of opinion that there is respecting the extralateral and discovery matter. For example, some consider that the tunnel rights provided in the existing law should be preserved; others think they ought to be abolished, or at least be limited. In the major matters there are also differences of opinion. The great majority of mining men agree in demanding the abolition of the extralateral rights and prerequisite of discovery provisions, but have not made up their minds as to just what should be substituted. With the grant of ownership within perpendicular lines, what should be the size of the claim? How many claims should one person be permitted to locate? On what terms should it be possible to acquire and hold such claims? If discovery be not required, what is to be the definition between mining and agricultural claimants of certain land? These are but a few of the questions regarding which public opinion has not yet crystallized.

In order to crystallize public opinion in these matters, there arose the conception of a commission to be appointed by the President of the United States to study the subject and make recommendations in detail, with the hope and expectation that these would command general approval.

This course of procedure was indorsed by the three national mining societies and by many of the state societies. Delegates from all of these assembled in Washington last December at the invitation of the Mining and Metallurgical Society of America, to bring directly to the attention of Congress the demand of the mining industry. The most remarkable thing about this convention, and of the actions that had preceded it during many years, was the extraordinary unanimity of opinion as to what was wanted and what should be done.

A bill providing for such a commission, introduced in the Senate by Senator Smoot, was reported favorably by the Senate's Committee on Mines and Mining on that very day. Soon afterward it was passed by the Senate and went to the House. In the meanwhile the Mines and Mining Committee of the House had been considering a similar bill introduced by Mr. Taylor, of Colorado. This committee began to hold hearings on Jan. 5, 1916.

There appeared in favor of Mr. Taylor's bill Senators Walsh of Montana, Smoot of Utah and Thomas of Colorado; Mr. Manning, director of the U. S. Bureau of Mines; John E. Raker, of California, N. J. Sinnott, of Oregon, Frank W. Mondell, of Wyoming, C. C. Dill, of Washington, and Joseph Howell, of Utah—all members of Congress; James F. Callbreath, secretary of the American Mining Congress; and Messrs. Ingalls, Channing and Finlay, of the Mining and Metallurgical Society of America. Against the bill appeared Hon. James Wickersham, delegate from Alaska in the House of Representatives and himself a member of the Mines and Mining Committee.

Messrs. Ingalls, Channing and Finlay appeared before this committee as officers of a professional society, elected by the votes of their fellow-members. They appeared as a matter of duty and as friendly advisers of the committee. They had the experience of having curses flung after them by Hon. James Wickersham, who waited, however, until

there was no danger of his being answered, and who also objurgated everyone acting in behalf of revision of the mining law whose name he could think of, including Mr. Sharpless, Mr. Winchell, Mr. Goodale, Mr. Requa, Mr. Mudd, Mr. Hammond, Mr. Sidney Jennings, Mr. W. L. Saunders, etc. The burden of his talk was that the only people who wanted to have the mining law revised were the representatives of the Guggenheims, the Rockefellers and what Mr. Wickersham was pleased to call the "Broadway interests." Here are some samples of his remarks:

Now, M. L. Requa is another good man. Mr. Requa developed the Nevada Consolidated Copper Co., and he built the Nevada Northern Ry. in Nevada and represented that part of the Guggenheim Copper Trust.

J. Parke Channing, who appeared here, has his office at 42 Broadway. Forty-two Broadway—that is the Amalgamated Co.'s office, isn't it? Now, we will just find out. It just struck me that that is the Amalgamated Copper Co.'s number. Here it is in "Poor's Manual of Industrials, 1915"—yes, New York office, 42 Broadway. . . . In other words, he is a copper man and has his office at the same number on Broadway with the Amalgamated, and being in the copper business and at the same number, he ought not to be on this commission, and this committee ought not to fool away very much time listening to him.

The first man on the list of speakers is John Hays Hammond. He has for many years been the Guggenheim agent in the examination of their great copper properties, and he is part and parcel of the American Smelting and Refining Co. now, just as much as Daniel of the House of Guggenheim is, and everybody knows it.

Next is Horace V. Winchell, whom you now know as the special representative of the Amalgamated.

Then W. L. Saunders appears. He is the president of the American Institute of Mining Engineers and one of the speakers. He is also a director in the International Harvester Co.; see "Poor's Manual of Industrials, 1915," page 388. Now, why a man who is a director in the International Harvester Trust should be taking such a deep interest in the revision of the United States Mineral Land Laws in the West you can guess as well as I can. The fiscal agent of that company is J. P. Morgan & Co., one of the partners in the Alaska Syndicate and Guggenheim Copper Trust.

Now those are the gentlemen who have appeared before this committee in person or by record and who are at the bottom of this whole proposition of getting this commission appointed. They all represent in some fair degree either the Amalgamated or the American Smelting and Refining Co. They are so close to that interest that if they do not represent anything in the way of mining revision, they represent the Copper Trust and little else, and I do not want them on a commission to revise the United States Mining Land Laws for Alaska, and I do not want their advice on any subject relating thereto.

With such remarks and others of similar character to the extent of many pages, Mr. Wickersham insulted, through its representatives, the entire mining-engineering profession. With this kind of "bunk," which is simply humorous to those who know how he was saying things that "ain't so," Mr. Wickersham fed this committee of "mining men" from Ohio, Indiana, Illinois, Florida, etc.

Then, to play up to his constituents in Alaska, Mr. Wickersham digressed into the crimes of the American Smelting and Refining Co., the Alaska Syndicate, and what not. He wanted to show how faithfully he stood on guard in the interest of the people; how, whenever a Guggenheim put up his head, he was ready to hit it. If it were not really a Guggenheim, never mind—call it one.

This has been a favorite play of Mr. Wickersham in the halls of Congress. But that he once had a different idea is exhibited in the following letter addressed to Stephen Birch, head of the Guggenheim interests in Alaska, which was printed in the *Congressional Record* for Feb. 5, 1914. This was offered during debate by Mr. Davenport, of Oklahoma, and was admitted by Mr. Wickersham to be a correct copy of the letter he wrote:

James Wickersham
Attorney at Law
Fairbanks, Alaska, Apr. 8, 1908.

Stephen Birch, Esq.,
Seattle, Wash.

My dear Mr. Birch:

Your letter of Mar. 17 has been received, and I hasten my answer that it may catch the last mail out over the ice.

I regret that I cannot meet you in Seattle the latter part of this month, because one can make one's ideas plainer in conversation than by writing, but since the opening of the April term of courts prevents it, I shall briefly state the matter by letter.

I have entered upon the practice of law here, and represent some of the most important interests in the Territory, and the outlook for returns is satisfactory; still I long for the fleshpots of the "outside," and would accept an offer from your allied Alaska interests to act as their general counsel, but not in any subordinate capacity. I will accept a three years' contract at $15,000 per annum, with offices in Seattle and office force and maintenance. Upon that sort of arrangement I would devote my time exclusively to their interests and give them the best service possible. My opportunities here, however, are so good that I could not afford to give them up for less than a three years' contract with you.

Please advise me by wire if anything is done in connection with this offer and it may be thus arranged.

Remember me kindly to Capt. Jarvis.

Very truly,
JAMES WICKERSHAM.

The bill providing for a commission to study and recommend revision of the mining law was rejected by the Mines and Mining Committee of the House by a majority of one vote. If any member of this committee were influenced by such arguments as Mr. Wickersham addressed to it he assumed a responsibility that does not reflect well upon his intelligence.

Steel Consolidations

The various combinations and consolidations in the steel trade, which have been generally discussed, have not, until recently, made much progress, although the times seem to be rather favorable financially for such movements. The consolidation of the Midvale Steel Co. with several other Pennsylvania companies as the Midvale Steel and Ordnance Co. is already a matter of record and was the first accomplished. This was followed by long negotiations over the proposed amalgamation of the Lackawanna Steel Co. at Buffalo, the Cambria Steel at Johnstown and the Youngstown Sheet and Tube Co., which at one time seemed quite probable. At the same time it was intimated that the merger might include the Pennsylvania Steel Co., although this was rather doubtful. The purchase of control of the Cambria and the Pennsylvania Steel companies was apparently made feasible by the fact that the Pennsylvania and the Reading railroad companies owned large blocks of stocks in those concerns, which they were quite willing to sell for a consideration. This consolidation finally fell through, apparently for three reasons: One was that the Syndicate which attempted it was not able to secure the necessary bank backing for its fianancial plans; another was some difficulty about underlying bonds of the different companies; and the third was the independent attitude of the Youngstown company, which is a very solid and substantial concern, whose stockholders were not inclined to sell out unless they secured what seemed to them a sufficient price.

Suddenly, and almost at the same time that the failure of these negotiations became apparent, the announce-

ment was made that the control of the Cambria Steel stock had passed to the Midvale Steel and Ordnance Co. on terms which have already been published and which included an offer to buy all the outstanding stock of the company. A few days later this was followed by an announcement, which was also unexpected, that the control of the Pennsylvania Steel Co. had been sold to the Bethlehem Steel Co., which had not before appeared in a serious way in the negotiations. This transaction included the purchase of the stocks held by the Pennsylvania and Reading railroad companies, a large block which had been gathered in by a Philadelphia syndicate and an offer to take the remaining stock which might desire to participate in the sale.

Taken by and large, this seems to be the most logical of all the consolidations and mergers that have been talked about. The Pennsylvania Steel Co., besides its own works, owns valuable properties, its subsidiaries including the Maryland Steel Co. and several coal and iron-ore properties, the latter covering some important and extensive mines in Cuba. Its works to perhaps an unusual extent supplement those at Bethlehem and will save that company the delay and cost involved in the construction of some extensions. It also has, in the Maryland Steel works, a large plant on tidewater and a shipbuilding plant, with facilities of a high class for handling iron ore and steel business for import and export. The Pennsylvania Steel Co. has not hitherto made what might be considered the best use of its facilities, largely because—as has been generally understood in the iron trade—it was badly in need of money to furnish working capital and pay for improvements. This deficiency the Bethlehem company is abundantly able to make up.

Whether any further consolidations will be carried out or attempted is uncertain. Quite possibly there will be some further adjustments, although at the present time it seems probable that the Lackawanna Steel Co. will not be included in any of them. The Youngstown company, which was so much talked about for a time, seems also likely to remain independent.

A point that is worthy of attention is that the consolidations already assured will put somewhere between 80 and 85% of the finished-steel production of the United States in the hands of seven companies. The United States Steel Corporation, of course, comes first, turning out last year about 45% of the total, although it is probable that this percentage will not increase in 1916, notwithstanding the opening of the Duluth works. Six other companies—the Bethlehem-Pennsylvania, the Jones & Laughlin, the Midvale-Cambria, the Republic and the Lackawanna—together turn out something close to 40% of the total, although their strength lies in different directions, the Midvale having the largest proportion of finished steel and the Republic the largest of pig iron.

It is probably safe to say that for a time at least there will be little further combination. It is also probably safe to say that the combinations that have been effected will put a stop to some projects for new construction, although they may result in the carrying out of some others. Steel-making capacity in this country is bound to be increased this year, probably rather by duplication at existing plants than by the construction of new ones.

Incidentally, it may be noted that the attempt to form a strong combination of Eastern merchant blast furnaces has fallen through, chiefly because the syndicate that attempted it was not strong enough. This syndicate, however, has secured the stock of the Wharton Steel Co., carrying with it the ownership of several blast furnaces and iron mines. This, however, makes simply a change of ownership, which had long been expected, since the Wharton properties have been on the market ever since the death of the late Mr. Wharton.

The Copper Stocks

The failure of the stocks of the copper-producing companies to figure among the war brides has been the subject of a good deal of comment. The standard stocks have risen, to be sure, but in no degree commensurate with the rise in copper. Let us make comparison with 1913, the last full year before the war began. In 1913 the price for copper did not fluctuate very widely. The highest monthly average was about 16½c. (in January). The lowest was about 14.2c. (in July). The average for the year was about 15¼c. This might be regarded as a normal year. We have taught ourselves to regard 15c. as about the price reasonably to be expected for copper over a long series of years.

In 1913 the "high" prices for a list of the well-known and well-seasoned copper stocks were as follows: Anaconda, 83; Chino, 47½; Miami, 26½; Nevada, 19¾; Ray, 22; Utah, 60⅝; Calumet & Hecla, 555; Calumet & Arizona, 72½; Copper Range, 53. About Feb. 1, 1916, with copper in the neighborhood of 25c., with the treasuries of the several companies filled with cash, with dividend rates increased by 50% and even twofold, the prices for these stocks were approximately as follows: Anaconda, 86; Chino, 53; Miami, 37½; Nevada, 16; Ray, 25; Utah, 80; Calumet & Hecla, 560; Calumet & Arizona, 71; Copper Range, 64.

Here is a group of industrial concerns of known resources, engaged in an industry regarding which there is more publicity both as to commercial conditions and corporate affairs than in the case of any other. Their earning capacity under normal conditions is well established, and the benefit that has accrued to them in the abnormal, highly favorable period of the last year is capable of close measurement. There is none of the uncertainty and mystery in this case that there is with respect to many of the munitions-manufacturing concerns, including Bethlehem Steel. Yet until a few weeks ago, when there was a little awakening of interest, many of the standard "coppers" were quoted at prices but little better than in 1913, although their position had been enormously improved.

The neglect of the "coppers" has been ascribed to several things, including the absorption of foreign holdings (especially of Anaconda, Utah, Chino, Ray and Miami), the absence of speculative leadership, the diversion of the interest of many important factors in the market to other quarters, and the slowness of investors to appreciate the changes that have been taking place in the copper-producing industry. It is likely that all of these conditions, and maybe others, have contributed to the sluggishness of the "coppers." Of course this does not matter to the owners of copper shares, who are getting wonderful returns in the form of dividends, save that all holders of securities like to see activity and strength in those in which they are interested.

BY THE WAY

The auction sales of aged and infirm mining stocks we find perpetually interesting. On Feb. 16 in New York 16,125 shares of Cordova Consolidated Mining Co. sold for $6 for the lot; 100 Edison Portland Cement Co., $16 lot; 200 of the same, $22 lot; 1,000 Trout Creek Copper Co., $6 lot; 500 California-Nevada Exploration Co., $6 lot.

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Our attention has been called to a statement in "The Mining News" of the *Journal* of Jan. 15, 1916, to the effect that certain mining companies operating on the Cuyuna and Vermilion Ranges of Minnesota possess ore high in manganese, some samples assaying as high as 55.57% manganese, while all samples averaged more than 50%. These reports came from two of our local correspondents; we regret that both of them were misinformed. According to reliable authorities, there is no manganese ore on these ranges. A very large quantity of manganiferous iron ore of no present commercial value was developed on the Cuyuna Range. The Vermilion ores will not average 0.15% manganese. There are mines on the Vermilion Range which have been in succession mines of iron ore, gold ore, graphite, copper ore and radium ore. Is it possible that these remarkable mines are now changing into deposits of high-grade manganese ore?

⁂

An engineer, tiring of the uncertainties of his profession, decided to go into business, according to *Engineering and Contracting*. So without investigating the proposition very carefully, be bought a gravel plant in a Southern state. After the papers had been signed and the former owner and engineer were alone, the latter said: "Now, see here, I want you to give me a few hints on how to run this business. I've used lots of gravel in my work, but I never tried to market is before." "Well stranger," said the ex-gravel dealer, "I wish I could give you some advice, but you see it was this here way: My father-in-law he left me the plant and the land in his will. I run her with my five sons, so I didn't have no payroll at all. My brother he works for the railroad, so I shipped out my gravel without no freight charges—and last year I came out just $1,100 behind." Some mines are like this.

⁂

We have read how gold mines have been discovered by mules and goats tearing up the earth, but it is seldom that a miner goes into his cellar to do a little digging and finds an iron-ore deposit. However, such an occurrence took place in Ishpeming, Mich., on the Marquette iron range. Last summer the Cleveland-Cliffs Iron Co. purchased the holdings of the Pittsburgh & Lake Angeline Iron Co., which included the famous Lake Angeline mine, at Ishpeming. The company owned a large number of dwellings situated close to the mine, one of which was occupied by an old Irish miner. This miner started digging in his cellar a few weeks ago and struck rich blue hematite at a depth of 3 ft. He reported the find to one of the company's engineers who was working nearby, and an investigation was started. A diamond drill is now working in his front yard, to prove the extent of the deposit.

The Bethlehem-Pennsylvania Consolidation

Rather unexpectedly, a formal announcement was made on Feb. 18 that the Bethlehem Steel Co. had bought a controlling interest in the Pennsylvania Steel Co. The purchase included the stock in the last-named company owned by the Pennsylvania and the Reading companies, which has been for sale for some time, and also a large block of stock that had been accumulated by the Donner-Replogle Syndicate, which at one time held an option on the railroad holdings which it was not able to carry out. It is understood that the Bethlehem company will purchase all stock of the other company that is offered at an even price. The purchase price is par for the preferred and about $27 per share for the common. The total outstanding stock is $20,587,500 preferred and $10,750,000 common. Payment is to be made in 5% purchase-money bonds of the Bethlehem corporation, secured by mortgage on the purchase property, with the reservation of a sufficient amount of bonds to retire underlying issues and provide for improvements and extensions. Smaller holdings, it is understood, will be paid for in cash.

The Pennsylvania Steel Co. owns its large steel plant and blast furnaces at Steelton, Penn., with blast furnaces also at Lebanon, Penn.; the stock of the Maryland Steel Co., with blast furnaces, steel plant and shipyard at Sparrows Point, Md., near Baltimore; the Spanish American Iron Co., with very extensive iron-ore deposits and mines in Cuba; a majority interest in the Cornwall Ore Banks in Pennsylvania; the Penn-Mary Coal Co., with a large coal area in Indiana County, Penn., together with several smaller subsidiary companies.

The purchase gives the Bethlehem company additions that will very well supplement its own plants, also considerable ore and coal reserves and especially a tidewater plant, which it has long desired. The Pennsylvania company will receive working capital, which it very much needs.

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Nevada Consolidated Report

The report of the Nevada Consolidated Copper Co. for the last quarter of 1915 shows a production of 18,287,930 lb. of copper—5,880,083 lb. in October, 5,495,487 lb. in November and 6,912,360 lb. in December. During the quarter 830,157 dry tons of Nevada Consolidated ore averaging 1.59% copper was milled. Of the ore milled, 92% was from openpits and 8% from underground workings in the Ruth mine. In addition 22,027 tons of Giroux Consolidated Mines Co. ore was milled.

The cost of copper produced, including Steptoe plant depreciation and all charges except ore extinguishment and after crediting all miscellaneous earnings, was 7.45c. per lb. Excluding depreciation, the cost was 6.72c. per lb. Earnings are computed on the basis of 21.699c. per lb. for copper, and that unsold is carried at 13.5c. per lb.

The surplus for the quarter was $1,739,468 after paying a dividend on Dec. 31 of 37½c. per share and an extra dividend of 12½c. per share. There was set aside $142,724 for plant and equipment depreciation and $82,228 for ore extinguishment, leaving a net credit to earned surplus for the quarter, of $1,514,515 and a balance of $4,849,556 in earned surplus.

PERSONALS

E. G. Spilsbury has been elected president of the Engineers' Club, of New York.

George E. Farish left New York, Feb. 19, for Oatman, Ariz., where he will be for the next two weeks.

C. H. James and R. S. Billings have opened offices at Kingman, Ariz., as mining engineers, metallurgists and assayers.

K. Shigeno, a member of the staff of Furukawa & Co., of Tokio, Japan, was in New York last week on his way to London.

John T. Reid who was recently in New York has returned to Lovelock, Nev. He expects to be in New York again about the middle of April.

Hugh B. Wick has been chosen president of the Elyria Steel and Iron Co., Cleveland, Ohio, in place of his father, Henry Wick, recently deceased.

Robert E. Cranston has been put in charge of the gold-mining department of the Anaconda Copper Mining Co. He left San Francisco Feb. 15 for Butte.

Dr. Charles E. Smith, chief chemist of the Mexican Petroleum Co., has gone to New Orleans to superintend the opening of the company's new refinery there.

C. E. Tobey has resigned his position as superintendent of the coal department of the Delaware, Lackawanna & Western Railroad Co. He has been with the company for a number of years.

At the recent annual meeting of the General Chemical Co. in New York, W. H. Nichols, Jr., was elected president in place of Sanford H. Steele, who was appointed general counsel, a new office.

Ludwig A. Thiele has opened an office as consulting chemical engineer in the Hartman Building, Columbus, Ohio. He has had much experience as a chemist and chemical engineer in Germany and the United States.

H. H. Harpham left Chicago last week for San Francisco, whence he will sail shortly for the west coast of Mexico to take charge of the property of the Mexico Development Co., near Manzanillo in the State of Jalisco.

James Richards, superintendent of the Isle Royale mine in the Michigan copper district, has gone to Florida on an extended vacation for the benefit of his health. A. H. Wahlrab is acting superintendent during Mr. Richards' absence.

W. Meischeke-Smith, of London, president of the Shell-Dutch Oil Co., visited Martinez, Calif., to note the progress of construction of addition to the refinery. Some of the ocean tankers have arrived and are ready for transportation of the company's products. Martinez is the central plant of the company.

William A. Burr has completed examinations of the Texas Flat and Waterloo group of gold mines of the Kroromick Mining Co. in Madera County, California. From there, he intends to visit Joplin, Mo., St. Louis, Chicago and New York and will then go to China to erect an antimony plant for the Wu Gen Co., near Canton.

Pierre Bouery, for 12 years manager of La Grange hydraulic mine, in Trinity County, California, started on Feb. 14 for Alaska, where he will take charge of the Valdez hydraulic mine, at Chitina, near Fairbanks. He was accompanied by Mrs. Bouery. He also took with him some of his most experienced hydraulic miners, Julius Kuhn, Otto Anderson, John Brandt and Frank Ternian. Mr. Bouery has made a world-famed success of the La Grange mine.

W. W. Inglis has been appointed general manager of the coal department of the Delaware, Lackawanna & Western Railroad Co. He has been for a number of years manager of the Pennsylvania Coal Co., which is controlled by the Erie. Frank H. Coughlin has been appointed assistant to the president. J. P. Jennings has been appointed general superintendent of the Northern division and W. B. Jennings, general superintendent of the Southern division of the company's mines.

Fred Searles, Jr., mining geologist, and William Mein, mining engineer, of Nevada City, Calif., started for New York on Feb. 13, whence they will sail for South Africa. They will be absent about three months and it is understood will make inspections for English investors. Searles recently played an important part in the apex suits, which involve the North Star and the Empire mines, at Grass Valley, and the Argonaut and Kennedy Extension, in Amador County; also in similar work for the Goldfield Consolidated. He is a graduate of the University of California and held the position of assistant professor of geology.

OBITUARY

James McGovern died at Franklin Furnace, N. J., Feb. 11, aged 55 years. He was, for a number of years, with the New Jersey Zinc Co., and was well known as a metallurgist and mineralogist.

T. L. Stephenson died at Knoxville, Tenn., Jan. 18, aged 53 years. He was born in Tennessee and had lived in Knoxville for many years. He was president of the Knoxville Iron Co. and of the Cross Mountain Coal Co. and was prominent in the iron business of East Tennessee.

William Evarts Tracy, of New York, died suddenly at Helena, Mont., Feb. 20, aged 39 years. He was born at Plainfield, N. J., and graduated from the Columbia School of Mines. He was for 10 years at the Liberty Bell mines, Telluride, Colo., leaving there to take a position on the engineering staff of the Anaconda Copper Mining Co. in Montana.

Gottlieb A. Steiner died in Pittsburgh, Feb. 18, aged 72 years. He was born and brought up in Pittsburgh, and after serving in the army, entered the employ of the old firm of Shoenberger & Co. He became a member of the company and finally vice-president, holding that position until 1899, when the works were taken over by the American Steel and Wire Co., and Mr. Steiner retired.

John D. A. F. Bendfeldt, a pioneer miner, died at Smiths Flat, Eldorado County, Calif., on Feb. 4, at the age of 88 years. He was a native of Germany, born at Hamburg. He came to America and went to California around the Horn in 1853 and was a resident of Eldorado County for 63 years. He owned and operated the Blue Lode or Bendfeldt deep gravel mine on the Deep-Blue-Lead at Smiths Flat.

William H. Davidson, well known in connection with the mining industries of British Columbia and northern Ontario, died at Galt, Ont., on Feb. 14. He was born in Galt and when a young man became interested in mining in the Kootenay district. Returning to Ontario he went to Porcupine in the early days of the camp and secured several rich claims. Latterly he was extensively interested in the Davidson-Joplin lead and zinc mines in Missouri. For the last five years he resided on a fruit farm near Simcoe, Ontario.

John Mitchell died at Jackson, Calif., on Feb. 1, of miner's consumption. He was ill for several weeks without hope of recovery. Mitchell was 67 years old, born in Cornwall, England, and came to America 50 years ago. After a few years in the East, he went back to England and in 1872 returned to America and to Amador County, California. He began his mining experience in the tin mines of Cornwall at the age of 7 years. In California he worked in the Bunker Hill and Little Amador mines in his early residence there, but for the last 13 years was employed at the Kennedy and continued until the disease prevented his performing any labor whatever.

SOCIETIES

The Acme White Lead and Color Works, of Detroit, maintains a fellowship in the University of Michigan, with a value of $500, for the study of problems connected with the manufacture of paints and varnishes. The holder of the fellowship for 1915-1916 is Ralph E. Christman.

American Institute of Mining Engineers—On Jan. 21, 1916, the board of directors authorized the establishment of a Nevada section of the Institute, whose territory includes the whole state of Nevada, with headquarters at Reno. The sponsors of this section are planning an opening session in April, and ex-President Saunders, of the Institute has promised to be present on this occasion.

Colorado Scientific Society held its regular monthly meeting, Feb. 5. The program comprised an interesting paper by S. S. Emery, of the Du Pont company, at Louviers, Colo., upon the "Manufacture of Nitroglycerin and Gelatin Powders"; and an address by Maj. J. B. Goodman, of the Colorado National Guard on "Small Arms and Three-Inch Field Pieces." That interest in the society is well sustained is manifest in the increasing attendance at the meetings this season. Its executive committee will have as guests at dinner, University Club, Feb. 26, officers of the local chapters of the various national engineerings societies, to discuss plans for coöperation along lines of mutual benefit.

NEW PATENTS

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

AIR DRYING—Method of Drying Air for Metallurgical Uses. Wilhelm Wense, Griesheim-on-the-Main, Germany, assignor to Chemische Fabrik Griesheim-Elektron, Frankfort-on-the-Main, Germany. (U. S. No. 1,169,371; Jan. 25, 1916.)

ALLOY—Copper Containing Boron. Edward D. Gleason, New York, N. Y., assignor to New-Metals and Process Co., Brooklyn, N. Y. (U. S. No. 1,169,536; Jan. 25, 1916.)

ALLOYS—Composition of Copper Alloys and Process of Manufacturing the Same. Francis C. Frary, Minneapolis and Sterling Temple, St. Paul, Minn. (U. S. No. 1,169,392; Jan. 25, 1916.)

ALUMINUM—Process for the Production of Aluminum. Heinrich F. D. Schwahn, Belleville, Ill. (U. S. No. 1,171,360; Feb. 8, 1916.)

ALUMINUM-PLATING PROCESS. Frederick Moench, Rushville, Ill. (U. S. No. 1,172,160; Feb. 15, 1916.)

ALUMINUM SALTS—Process of Producing Soluble Salts of Aluminum. Melville F. Coolbaugh and Elwyn H. Quinney, Rapid City, S. D. (U. S. No. 1,170,418; Feb. 1, 1916.)

AMALGAMATOR. Achilles Allen, Milton, Ore., assignor of one-third to Thomas Crowley Frazier and one-third to Ora Estes Smith, Milton, Ore. (U. S. No. 1,172,099; Feb. 15, 1916.)

AMALGAMATOR—Ore Amalgamator. James E. Dick, Akron, Ohio. (U. S. No. 1,169,740; Jan. 25, 1916.)

ANNEALING FURNACE. Charles F. Kenworthy, Waterbury, Conn. (U. S. No. 1,169,494; Jan. 25, 1916.)

BARIUM CHLORIDE—Process of Manufacturing Barium Chloride. Einar Vang Granö, Leonia, N. J. (U. S. No. 1,167,-061; Jan. 4, 1916.)

BLAST FURNACES—Controlling Apparatus for Metal Flowing from Blast Furnaces. James S. Fraser, Charleroi, Penn. (U. S. No. 1,169,247; Jan. 25, 1916.)

CAGE—Mine Cage. Paul W. Holstein, Columbus, Ohio, assignor to The Jeffrey Manufacturing Co. (U. S. No. 1,168,-501; Jan. 18, 1916.)

CLASSIFYING—Apparatus for and Process of Classifying Minerals. Robert H. Richards, Boston, Mass. (U. S. No. 1,170,-848; Feb. 8, 1916.)

CONCENTRATOR. William H. Miller and Guy E. Kratzer, Chico, Calif. (U. S. No. 1,170,925; Feb. 8, 1916.)

COPPER—Process of Uniting Copper to Ferrous Metals. William Marshall Page, Chester, Penn. (U. S. No. 1,171,066; Feb. 8, 1916.)

CRUCIBLE FURNACE. William Milton Brown, Johnstown, Penn. (U. S. No. 1,171,500; Feb. 15, 1916.)

CYANIDING—Bagholder. Harry R. Conklin, Joplin, Mo. (U. S. No. 1,169,241; Jan. 25, 1916.)

DREDGING—Spud Lowering and Hoisting Means for Dredges. Hugh T. Groves and D. Roy Groves, Portland, Ore. (U. S. No. 1,169,396; Jan. 25, 1916.)

DRIER. William B. Ruggles, Bayonne, N. J. (U. S. Nos. 1,171,143 and 1,171,144; Feb. 8, 1916.)

DRILL. William Henry Wakfer, South Norwood, England, assignor of one-half to Samuel Peck, Wallington, England. (U. S. No. 1.169,369; Jan. 25, 1916.)

DRILL-TESTING APPARATUS. Earl H. Obertop, Goldfield, Nev. (U. S. No. 1,172,163; Feb. 15, 1916.)

DRILLING or Boring Tool. William Maine Treglown and William Noble, London, England, assignors to Ingersoll-Rand Co., Jersey City, N. J. (U. S. No. 1,169,582; Jan. 25, 1916.)

DRILLING—Spring-Muzzle for Rock-Drilling Engines. William T. Ayer, Dover, N. J., assignor to McKiernan-Terry Drill Co., Dover, N. J. (U. S. No. 1,170,501; Feb. 8, 1916.)

DRILLS—Chuck for Rock Drills. James C. H. Vaught, Detroit, Mich. (U. S. No. 1,171,009; Feb. 8, 1916.)

ELECTRIC FURNACE—Method of Carrying Out Gas Reactions in an Electric Furnace. Alois Helfenstein, Vienna, Austria-Hungary. (U. S. No. 1,169,817; Feb. 1, 1916.)

EXCAVATING—Hoisting Machinery for Operating Grab Buckets. Augustus Smith, North Plainfield, N. J., assignor to Bergen Point Iron Works, Bayonne, N. J. (U. S. No. 1,170,463; Feb. 1, 1916.)

EXCAVATING—Swinging Mechanism for Booms of Excavating Machines. Charles B. King and Benjamin Jacoby, Marion, Ohio, assignors to The Marion Steam Shovel Co., Marion, Ohio. (U. S. No. 1,169,836; Feb. 1, 1916.)

FERROSILICON—Process of Producing Ferrosilicon. Herbert Champion Harrison, Niagara Falls, N. Y., assignor to Electro Metallurgical Co., Niagara Falls, N. Y. (U. S. No. 1,171,719; Feb. 15, 1916.)

FLOTATION—Concentration of Ore. Edward Holt Nutter, San Francisco, Calif., assignor to Minerals Separation American Syndicate (1913), Ltd., London, England. (U. S. No. 1,170,-665; Feb. 8, 1916.)

FLOTATION—Ore Concentration. Arthur Howard Higgins, London, England, assignor to Minerals Separation American Syndicate (1913), Ltd., London, England. (U. S. No. 1,170,637; Feb. 8, 1916.)

FURNACE—Metallurgical Furnace and Furnace Parts. Theodore W. Muckle, Denver, Colo., assignor to Willis W. Case, Jr., Denver, Colo. (U. S. No. 1,172,222; Feb. 15, 1916.)

FURNACE-DOOR FRAME. Luther L. Knox, Avalon, Penn., assignor to Knox Pressed and Welded Steel Co., Pittsburgh, Penn. (U. S. No. 1,168,649; Jan. 18, 1916.)

GAS SCRUBBER. Henry A. Carpenter, Sewickley, Penn., assignor to Riter-Conley Manufacturing Co., Pittsburgh, Penn. (U. S. No. 1,170,510; Feb. 8, 1916.)

GAS WASHING—Method of and Apparatus for Recovering Sludge. Hermann A. Brassert and Walther Mathesius, Chicago, Ill. (U. S. No. 1,171,696; Feb. 15, 1916.)

GEOLOGIST'S CALCULATING DEVICE. Warren J. Mead, Madison, Wis. (U. S. No. 1,171,741; Feb. 15, 1916.)

HYDRO-ELECTROLYTIC TREATMENT OF ORES, Method for the. Robert Rhea Goodrich, Tucson, Ariz. (U. S. No. 1,171,782; Feb. 15, 1916.)

INGOT MOLD. Emil Gathmann, Baltimore, Md. (U. S. No. 1,170,629; Feb. 8, 1916.)

IRON-ORE TREATMENT—Improved Process of Treating Iron Ores to Obtain a New Product for Use in Smelting. D. V. Hollingworth and R. C. Macgowan. (Brit. No. 18,103 of 1914.)

IRON SULPHIDE—Process for Producing Iron Sulphide. Napoleon Petinot, New York, N. Y., assignor to The Titanium Alloy Manufacturing Co., New York, N. Y. (U. S. No. 1,169,092; Jan. 18, 1916.)

LEACHING TANK. Harry H. Stout, New York, N. Y., assignor to Nichols Copper Co., New York, N. Y. (U. S. No. 1,169,205; Jan. 25, 1916.)

LEAD ARSENATE—Method of Manufacturing Arsenate of Lead. Edwin O. Barstow, Midland, Mich., assignor to The Dow Chemical Co., Midland, Mich. (U. S. No. 1,169,114; Jan. 25, 1916.)

LEAD CHROMATES—Process of Preparing Chromates of Lead. Alexander S. Ramage, Buffalo, N. Y., assignor to International Color and Chemical Co., Inc., Detroit, Mich. (U. S. No. 1,168,417; Jan. 18, 1916.)

MAGNESIUM CHLORIDE—Improved Manufacture of Magnesium Chloride. W. S. Rawson, London, England. (Brit. No. 21,261 of 1914.)

METALS—Process of Working Clad Metals. William Marshall Page, Philadelphia, and Wirt Tassin, Chester, Penn., assignors, by mesne assignments, to Duplex Metallic Co. (U. S. No. 1,171,637; Feb. 15, 1916.)

MINE-SHAFT ROLLER. John Gemmell, Calumet, Mich. (U. S. No. 1,171,039; Feb. 8, 1916.)

OIL—Process for Recovering Oil and Other Products Which Are Formed During the Destructive Distillation of Wood. Louis Hanson, Wilmington, N. C. (U. S. No. 1,169,956; Feb. 1, 1916.)

ORE POCKET—Self-Clearing Ore Pocket. Leland Clapper, Two Harbors, Minn. (U. S. No. 1,172,007; Feb. 15, 1916.)

ORE TREATMENT—Apparatus for and Process of Ore Treatment. Arthur S. Dwight, New York, N. Y. (U. S. No. 1,169,139; Jan. 25, 1916.)

ORE TREATMENT—Apparatus for the Treatment of Ores Containing Silver. Erich Langguth, Neerpelt, Belgium. (U. S. No. 1,169,270; Jan. 25, 1916.)

PEAT—Utilization of Peat. Thomas Rigby, Dumfries, Scotland, assignor to Wetcarbonizing, Ltd., London, England. (U. S. No. 1,170,849; Feb. 8, 1916.)

POWER-TRANSMITTING DEVICE. Francis D. Weeks, Salida, Colo., assignor to The Ohio & Colorado Smelting and Refining Co., Denver, Colo. (U. S. No. 1,170,945; Feb. 8, 1916.)

PULVERIZER. Ray C. Newhouse, Milwaukee, Wis., assignor, by mesne assignments, to Allis-Chalmers Manufacturing Co. (U. S. No. 1,171,747; Feb. 15, 1916.)

PULVERIZING APPARATUS. William K. Liggett, Columbus, Ohio, assignor to The Jeffrey Manufacturing Co. (U. S. No. 1,169,501; Jan. 25, 1916.)

REGENERATIVE FURNACE. Alfred Steinbart, Pittsburgh, Penn. (U. S. No. 1,169,296; Jan. 25, 1916.)

ROASTING—Improvements in the Roasting of Sulphur-Bearing Ores. Nichols Copper Co., New York, N. Y. (Brit. No. 9,958 of 1915.)

SAMPLING DEVICE. Ray C. Newhouse, Milwaukee, Wis., assignor to Allis-Chalmers Manufacturing Co., Milwaukee, Wis. (U. S. No. 1,170,842; Feb. 8, 1916.)

SCREEN—Vibrating Screen. William K. Liggett, Columbus, Ohio, assignor to The Jeffrey Manufacturing Co., Columbus, Ohio. (U. S. No. 1,171,058; Feb. 8, 1916.)

SHERARDIZING—Process of Sherardizing. Edgar F. Collins and John A. Capp, Schenectady, N. Y., assignors to General Electric Co. (U. S. No. 1,169,529; Jan. 25, 1916.)

SINTERING—Apparatus for Sintering and Smelting Ores. Arthur S. Dwight, New York, N. Y. (U. S. No. 1,169,384; Jan. 25, 1916.)

SINTERING DEVICE. Max McMurray, Cleveland, and Benjamin J. Mullen, Leetonia, Ohio; said Mullen assignor to United Iron and Steel Co., Cleveland, Ohio. (U. S. No. 1,169,336; Jan. 25, 1916.)

SLAG—Treatment of Slag for the Manufacture of Bricks and for Other Purposes. Edgar Rouse Sutcliffe, Leigh, England. (U. S. No. 1,171,676; Feb. 15, 1916.)

SMELTING—An Improved Furnace for Smelting Ores. C. J. Beaver and E. A. Claremont, High Leigh, Cheshire, England. (Brit. No. 6,675 of 1915.)

SMOKE AND DUST CONSUMER. Andrew Pool and Ralph Kaan, Indiana Harbor, Ind. (U. S. No. 1,171,750; Feb. 15, 1916.)

STEEL—Process of Treating Steel. C. H. A. F. L. Ross, Rosshire, England. (Brit. No. 5,269 of 1915.)

SULPHUR—Apparatus for Operating Sulphur Wells. William Daniel Huff, La Fayette, La., assignor of three-fourths to Louise Guidry Moss, New Iberia, La. (U. S. No. 1,170,266; Feb. 1, 1916.)

TIN—Improved Construction of Apparatus for Casting Tin and Other Metals or Substances. F. C. Bell and Cornish Tin Smelting Co., Ltd., London, England. (Brit. No. 21,685 of 1914.)

ZINC—Apparatus for the Extraction of Zinc. Martin M. Pearlman, Clarksburg, W. Va. (U. S. No. 1,167,925; Jan. 11, 1916.)

ZINC—Process of Extracting Zinc From Its Ores. Frederick Laist and Frederick F. Frick, Anaconda, Mont. (U. S. Nos. 1,167,700 and 1,167,701; Jan. 11, 1916.)

Editorial Correspondence

SAN FRANCISCO—Feb. 17

Increase in Wages of Copper Miners in Shasta County has been made voluntarily by the Mountain Copper, the Mammoth and the Balaklala. The first named company informed its men on Feb. 8 that while the price of copper remains as high as 20c. per lb. they are to receive an additional 25c. per day, beginning with Feb. 1. The Mammoth and Balaklala announced a bonus of 25c. per day to all men who worked for one month; the bonus to continue so long as copper remains as high as 20c. per lb.

General Petroleum Co.'s Earnings in the year 1915 amounted to approximately $2,000,000; net after payment of interest and preferred dividend was $1,450,000. The yield represented 11.6% on $12,500,000 bonds at par and 23.2% on the same amount of bonds at 50. The increased-earning power of the company is said to be a surprise to many of the security holders. In the year 1913, the company reported an operating profit, before charges, of only $286,567, and in 1914 of only $655,181. In those years the company carried a large number of unprofitable contracts. The improvement has been made under the management of John Barneson and the financial tangle was straightened out by the reorganization committee.

The Storm in the California Oil Fields, reported authentically by the department of petroleum and gas of the State Mining Bureau, wrecked approximately 2,000 derricks. This is about 25% of the total number of producing wells in the San Joaquin Valley, which embraces Coalinga, Kern River, Midway and McKittrick fields. There will consequently be a shortage of oil production in February, amounting possibly to 40,000 bbl. per day; or more than 15% of recent monthly totals. Rebuilding of derricks will cost about $400 each, or a total of approximately $750,000, of which about one-third will be for labor. So far no method or type of derrick construction has been devised that will prevent similar loss from the same cause in the future. Increased drilling activity is expected in the next few months and an increase in production when the damage done by the storm has been repaired.

Coleman Interests in the Guadalupe Quicksilver Mine in Santa Clara County, Calif., have been purchased by H. C. Davey and associates. Mr. Davey has for several years been the general manager of the property and part owner. The principal part of the stock was held by James V. Coleman, of San Francisco and his two sisters, Countess d'Andigne, of Paris, and Mrs. Isabella C. May, of Washington. The deal was made by William J. McGee, U. S. sub-treasurer at San Francisco. The Guadalupe was discovered in the early '50s and was subsequently acquired and operated by the Santa Clara Mining Association of Baltimore, Md. The Guadalupe Mine Co. of California purchased the property in 1875 and made large surface improvements, installing reduction works and mining machinery. Up to 1886, the mine produced 55,910 flasks of quicksilver. From that time until 1900, the mine was idle most of the time. In that year H. C. Davey organized the Century Mining Co. which remodeled the plant and unwatered the mine. In 1901, new orebodies were disclosed and the mine has made a production that has kept it in position of second place in the list of quicksilver producers most of the time since. The production reached as high as 6,000 flasks in a year. In the period that the Guadalupe was idle, the New Almaden which adjoins the Guadalupe, was a large producer and during the earlier years of Mr. Davey's management, the Guadalupe was in third position, being exceeded in the amount of quicksilver produced by the New Almaden; the New Idria being the largest producer in the state. Managerial troubles, about three years ago, put the New Almaden in third place and Guadalupe in second place. Later the Guadalupe was reorganized as the New Guadalupe Quicksilver Co. and under that name made its largest production since the mine was reopened. The purchase price is said to have been more than $250,000. The reason for disposal of the Coleman interests are not made public. The Guadalupe has been well equipped since Mr. Davey became manager.

Tungsten Deposits in the eastern side of San Bernardino County are being developed and commercially operated. The greatest activity appears to be in Kelso district, situated about 90 mi. east of Barstow and on the main line of the Los Angeles, San Pedro and Salt Lake Ry. This district is noted particularly for iron and chromium. The tungsten activity extends northeast to Cima and Ivanpah districts, which are situated, one within 20 mi., the other within 5 mi. of the Nevada state line. Cima is a silver-bearing district and in Ivanpah district copper is predominant. The Globe Mining Co. and others are said to be mining tungsten on a large scale in Kelso district and making shipments by express. Tungsten claims are being located at Cima and Ivanpah, and the indications reported point to the possibility of a large production in those two districts. There is no question as to the existence of scheelite all the way across San Bernardino County from Atolia to the Nevada state line. Little attention was paid to the statements of prospectors regarding the extensive belt of granitic rocks on the desert and slight elevations, chiefly because at that time the demand for tungsten ores was not sufficient to encourage prospecting and development. And it was difficult to attract investors who had the means and the knowledge for development and operation of prospects. These deposits now being operated and located were, a year or two ago, considered merely prospects, and some of them offering very poor opportunity for profitable development. The chances are now that the entire desert country for a distance of more than 100 mi. east and west and 20 mi. north and south will be very thoroughly prospected and a large area may be developed, resulting in opening up some very good tungsten mines. In the vicinity of Atolia and Randsburg, in addition to the Atolia Mining Co. property, the large amount of development going on is increasing daily and will largely add to the output of the Atolia Mining Co.'s mill. The new mill, which was partially destroyed by fire, is being rebuilt, and it is understood that the capacity will be increased from 100 to 200 tons.

DENVER—Feb. 17

Colorado Fuel and Iron Co. has announced to its employees that increases in their wages became effective Feb. 1, but the exact nature of the betterment is not yet explained.

Denver Mint Received, during 1915, $34,268,443 worth of gold and $574,175 worth of silver. These figures combined show an increase of $588,663 over the receipts for 1914. Of the total gold received, Colorado accounted for $14,303,768, or about 41½%; while the state furnished silver to the value of $296,688, or about 51¾% of the total.

The Plant of the United States Reduction and Refining Co., at Colorado City—ordinarily called the Standard mill—will be sold at auction Saturday, Apr. 15, according to decision of Federal Court in bankruptcy. It is expected that the works will be bid in by the Golden Cycle M. and R. Co. and that much of the machinery will be utilized in this company's great plant at the same place.

Roosevelt Tunnel—otherwise known as the Cripple Creek Deep Drainage Tunnel—has crossed the Elkton dike and its breast is in breccia. An unusual flow of water has been released, the depth of flow through the tunnel being about 5 in. deeper than ever before noted. It amounts to fully 20,000 gal. per min. and is so strong that work is practically stopped. Supt. Fuller, with his trained crew of hardy tunnelers, is exerting every effort to proceed and hopes daily that the flow will somewhat abate.

Vindicator Consolidated Co.'s Annual Report to stockholders contains information from General Manager Irving T. Snyder that a flotation mill of not less than 100 tons, and probably 300 tons, capacity will soon be provided to treat low-grade ore. The plan contemplates remodeling the old Golden Cycle concentrator. If operations on this first scale prove agreeable, there is planned "a large and thoroughly modern flotation mill of not less than 1,000 tons' daily capacity." Experts have been working on Vindicator and Golden Cycle ores for months and have succeeded in making recoveries of 90% of the gold at a cost of less than $1 per ton.

Gordon-Tiger Mine, at Twin Lakes, was the scene of a tragedy, Feb. 9, in which Dr. G. S. Rider, of Wilmette, Ill., was shot by E. K. Sackett, a contractor from Telluride, Colo. Rider was a heavy stockholder in the company that, a year ago, took over this old mine and, under the management of George W. Boyce, has since been reopening and equipping it for modern operation. Sackett had constructed an aërial tramway from the mine to its mill and a disagreement arose

over the monetary settlement. Doctor Rider died in a Leadville hospital next day. Sackett pleads that he had been exasperated by a delay in receiving his stipulated price and feared a repetition of a recent loss on another contract, and that Rider had threatened him bodily.

Caribou Mines and Mills Co. is the new owner of the Caribou and Poorman mining groups in Boulder County that were reopened about two years ago, after long idleness, by the Cariman Mining and Milling Co. of which Henry T. Lowe was promoter and manager. This company went into bankruptcy last November. Officers of the new company are Frederick H. Wickett, Chicago, president; George L. Nye, Denver, vice-president; I. A. West, secretary; and W. C. Russell, general manager. The Caribou was located in 1870 and for years was ranked as one of Colorado's greatest silver mines; its output for a single year having been more than $1,000,000. The Poorman property is essentially a gold property at Cardinal whence a development and drainage bore, known as the Boulder County Tunnel, was formerly driven more than a mile toward the Caribou workings.

BUTTE—Feb. 17

A Reward of $250 Was Offered, on Feb. 10, by Governor S. V. Stewart, of Montana, for the arrest and conviction of any person or persons engaged in attempting to sell stock in Montana by any fraudulent representations. The object of the proclamation is to discourage the sale of mining, oil and other stocks by unscrupulous concerns that have sprung up like mushrooms all over the state and have taken advantage of the prevailing spirit of speculation to unload valueless stock on unsophisticated buyers.

Western Federation Suit, Butte—Trial of suit of Western Federation of Miners against Butte Miners' Union to recover property valued at $50,000, which was held in Federal Court, was concluded Feb. 12. Court took case under advisement. Charles Mahony, vice-president of federation, and E. Mills were principal witnesses for plaintiff. Latter contended that union property in Butte belongs to Federation, because local union did not fulfill contract embodied in charter by which it gained membership in Federation. Defendant contended that Federation did not perform its part of contract in failing to give union protection and aid when needed and that charter upon which Federation is basing its claim was never accepted by Butte union, and is different from original charter which was destroyed during the blowing up of Union Hall in June, 1914. In rebuttal, plaintiff submitted evidence that original charter contained the forfeiture clause objected to by defendant.

Placer and Quartz Mining on the Increase—The Conrey Mining Co., which for several years has been successfully operating four large dredges in Alder Gulch district, has purchased a large amount of additional ground, said to be underlaid with gravel containing considerable percentage gold. With starting of dredging operations and with conditions ripe for a general revival of mining industry in Montana, mining has taken a spurt in this county which promises to result in development of large number of claims that have lain idle for years. Among promising properties being worked at present are the Missouri mine, at head of Madison Creek, owned by Elling Estate, which produces ore running $200 in gold per ton. On Ramshorn Gulch, the Betsy Baker is under bond to a Canadian company, which will build a concentrator this spring. In the Sheridan district, the Lake Shore is being operated by the Investors' company, of Cleveland, which also has a concentrator running. Rohn Bros. is operating the Tamarack on a high-grade lead, carrying values from $100 to $400 a ton. A. B. Clark is developing several claims in the Brandon district. In Bear Gulch, Higgins and Bielenberg are running their mine at full capacity and the Little Goldie is shipping from three to four cars of ore a month. The Old Revenue mine on ridge between Norris and Meadow Creek has been reopened and is being put in shape for continuous operation.

SALT LAKE CITY—Feb. 18

Oil Drilling in Tooele County is looking up. The well now being driven north of Grantsville is about 400 ft. deep and the prospects are very encouraging. Twenty well-known citizens of Tooele City have located 3,200 acres of land near this well and contemplate beginning to drill in the near future. James B. Hickman is president, Walter Sykes, vice-president, and Sol J. Selvin is treasurer.

The United States Surveyor General, I. C. Thoresen, of the local office, has announced a reduction of $10 in the deposit for the survey of mining claims in this district. The reduction has been authorized by the Federal Government, and will go into effect at once. Previously a deposit of $30 has been required for each claim—now reduced to $20—with an additional $5 for each known conflict. By taking the records of work done in former years it was found that each survey cost approximately $20, and this sum was fixed for future surveys.

The Salt Lake Stock and Mining Exchange at its annual meeting recently elected a board of governors for the ensuing year as follows: B. W. Dixon, J. A. Hogle, H. B. Cole, F. R. Woolley, A. L. Jacobs, F. C. Dern, M. P. Braffet, R. A. Badger, and W. D. Nebeker. A report on the business transacted during the past year was given by Secretary James A. Shorten, who called attention to an increase of over 500% in the number and value of shares sold as compared with 1914. The new board of governors then met and elected M. P. Braffet, president; B. W. Dixon, H. B. Cole, F. C. Dern, vice-presidents; G. P. Norton, treasurer, and James A. Shorten, secretary. The following committees were appointed: Arrangements committee, W. D. Nebeker, chairman; membership committee, J. A. Hogle, chairman; rules committee, R. A. Badger, chairman; arbitration, F. R. Woolley, chairman; listing, A. L. Jacobs, chairman.

WALLACE, IDAHO—Feb. 15

A Case of Unusual Importance to the mining industry of the Coeur d'Alene district was heard by the Public Utilities Commission in this city recently. The case is the outgrowth of a complaint filed about a year and a half ago with the Utilities Commission by the Federal and other mining companies against the Washington Water Power Co., alleging excessive charges for electric power. About that time the complainant company and others entered into arrangements with the Montana Power Co. and its subsidiary, the Thompson Falls Power Co., to furnish it power. Up to that time the Washington Water Power Co. had enjoyed a monopoly of this large and rapidly growing field, and naturally viewed with alarm the possibility of having a formidable competitor from Montana. For some reason unexplained, the Montana company did not apply to the utilities commission for a certificate of necessity which is required of public-service corporations before they can do business in Idaho, but an indirect method was adopted by the Montana Power Co. and the local mining companies which desired to be served by it, according to the allegation of the Washington Water Power Co., by which it is doing business in this state without complying with the law to which all other similar corporations are subjected. And this was the real issue involved in the hearing before the utilities commission—the right of the Montana Power Co. to do business in this state. It is a fight between two giant power corporations entrenched in border states on opposite sides of the panhandle of Idaho; the Washington company determined to drive its rival from the rich field in which it has long held undisputed sway and the Montana company equally determined to hold the footing already gained and extend its lines further as opportunity offers. In order to get around the provision of the law requiring public-service corporations to secure a certificate of necessity in order to do business in Idaho, the last legislature, upon representations made by mining companies interested, passed a law permitting Idaho companies or individuals to construct at their own expense electric-power transmission lines to the state line and there receive electric energy from foreign corporations which are not authorized to do business in the state. Under this law the Montana Power Co., or its subsidiary, the Thompson Falls Power Co., extended its line from Thompson to the Idaho-Montana line, where it was met by a line from this side. It was understood prior to the hearing that this line was erected by the Federal Mining and Smelting Co., but it was admitted in the hearing that it was built and paid for by the Montana company and that by the terms of a subsequent agreement the Federal and other companies being served by the Montana company repaid the power company for the outlay. It is contended that the companies now being served by the Montana Power Co.—the Federal, Hercules, Tamarack & Custer and Interstate-Callahan—are receiving power in compliance with the special act of the legislature and that they and the Montana Power Co. are acting within their legal rights. On the other hand the Washington Water Power Co. contends that the construction of the line from the mines to the state line by the Montana company was a violation of the law regulating such corporations in Idaho, and the evidence also drew out other facts calculated to prove that the Montana company was actually doing business in Idaho; and that if these acts were in conformity with the special act of the legislature, then it is contended by the Washington company that the act itself is invalid. The commission will probably render a decision in March.

SPRUCE PINE, N. C.—Feb. 11

Feldspar Mining in North Carolina at the present time is experiencing quite a boom. It is reported that the Products Sales Co has let contracts calling for a large tonnage of second-grade feldspar which is being shipped to southern points for the manufacture of fertilizer. Understood that 300,000 tons have been contracted on behalf of American Fertilizer Co.

SPOKANE, WASH.—FEB. 15

The Consolidated Mining and Smelting Co., of Canada, which owns and operates the Le Roi, War Eagle and Centre Star groups of copper-gold mines in Rossland, the Sullivan, St. Eugene and several smaller lead-silver zinc properties in the Ainsworth-Slocan region, and a smeltery at Trail, now the largest corporation operating in British Columbia, has increased its capitalization from $7,500,000 to $15,000,000. The funds derived from the augmented capitalization will be devoted to financing construction of additions to the smeltery at Trail and to the purchase of the common stock of the West Kootenay Power and Light Co. In this deal Lorne A. Campbell, member of Parliament from the Rossland constituency, recently appointed Minister of Mines for British Columbia, is the controlling factor.

The West Kootenay Company has a power station at Bonnington Falls, on the Kootenay River, midway between Nelson and Slocan City. It is developing approximately 50,000 hp., and it is said that the energy production can be increased largely at comparatively small expense. The plant provides current for the Granby Consolidated company's smelter at Grand Forks and its mines at Phoenix, the British Columbia Copper Co.'s smelter at Greenwood and the Canadian Consolidated company's reduction works at Trail. The latter is consuming 9,000 hp. daily, and the consumption probably will be increased to 12,000 hp. as soon as the new electrolytic zinc smeltery and copper refinery are in operation.

HOUGHTON, MICH.—Feb. 19

The Production of Copper from the mines of the Lake Superior district, during first month of 1916 was 7,000,000 lb. under December, 1915, and at least 9,000,000 lb. under anticipated product. Costs of production were higher than at any time in recent years and considerably higher than at any time during 1915. The production for February of 1916 will not be more than 20,000,000 lb. for whole district. By same token the costs for February will be high. This is largely due to the fact that January witnessed worst blizzards district has seen in 30 years.

Shipments of Metal by the smelters of the Lake Superior district continue hot from the furnaces. During the months of December and January the railways of this district shipped out 40,000,000 lb. of copper. This does not represent the output of the mines of this district for the two months. It includes a good deal of November copper and comparatively little January copper produced from the mines. The copper that is produced from the mines usually does not leave the smelter for 15 or 20 days, even in cases of great rush and in ordinary normal times the product frequently is retained at the smelter for several months.

Resumption of Operations at the Ojibway or a combination of several properties in that vicinity with the Ojibway is now talked of. Officials of the company say that nothing in the way of a resumption is planned at present. Dr. L. L. Hubbard, who is president of the company, says that he never has lost faith in the merit of the property and believes that with metal at its present price the two Ojibway shafts could be put in shape for profitable operation. While the tests of Ojibway rock, made at the Tamarack mill, were far from satisfactory, the fact remains that the tests were from a limited area and there is no doubt that the drill-core results showed as good a general average of the Kearsarge lode as any in the district. Since the mine shut down, some years ago, the developments at the Mohawk shafts, Nos. 1 and 2, have so much improved in the quality of their rock, as to give encouragement as to the Ojibway possibilities. The Mohawk shafts in question are the original Mohawk developments and adjoin Ojibway, on the immediate south. Before Ojibway can hope to reopen, the financial problem will have to be settled as it will entail considerable immediate outlay. The Ojibway has at least 2,000 ft. of fairly good ground now opened and ready for immediate mining, ground that could show a profit on present metal figures.

Further Development and Exploration Work on Isle Royale will start in the spring. Reference is made to the island in Lake Superior, not the Isle Royale mine south of Houghton. This Isle Royale land, over 90,000 acres, two-thirds of the total acreage of the island, has been explored in a desultory sort of way at numerous times. A few years ago it passed into the hands of Thomas F. Cole and associates. Diamond drilling and shaft exploring will start soon. The history of the island dates back to the times when American politicians did not take much stock in the peace-at-any-price talk. The old-fashioned school histories tell of the quarrel of the commissioners of Great Britain and the United States relative to this island. The British commissioners wanted it for Canada, basing their claim that it was nearer the Canadian mainland than the United States line. Our commissioners finally found it necessary to take the stand "Isle Royale or fight." The first work was done on this island back in the earlier developments of copper in Michigan and it was do e by an English corporation. As in the case of every English or French corporation that owned copper-bearing territory in this section the officials in charge were capable of two things, being royal entertainers and spending the money of their clients with a prodigal hand. And when the money was spent the work on Isle Royale stopped. There are numerous evidences of the crude attempts to find mass copper by test-pits which were sunk at shallow depths in many places and in some instances with some degree of success. The work now planned will be conducted with all modern facilities.

MORENCI, ARIZ.—Feb. 16

The Loss of a Great Many Mine Records and official denouncements by several mining companies in northern Sonora during the raids and counter-raids of Mexicans last year, is the cause of considerable concern. The Mexican tax officers cannot tell who has paid taxes or who has title to property. Although, it is said, the Carranza officials are acting liberally in the matter, the mining laws of Mexico are very strict and a small error might prevent title being issued. As copies of all official records are supposed to be on file in Mexico City, however, all controversies may finally be settled. Prospectors are busy in Sonora looking for tungsten and some fair samples have already shown up. The San Nicolas, in the Sahuaripa district, owned by James Douglas, of Douglas, is the only known tungsten producer in the district. It has shipped regularly through Nacozari for a long time and is said to contain large bodies of commercial tungsten ore. The breaking of the power line between the Copper Queen power house and the El Tigre mine during a snowstorm caused the mill to lose three days in January, which resulted in reducing the output from the normal 225,000 oz. to 200,000 oz. silver. El Tigre now employs about 550 men.

The Employees of the Detroit Copper Co. went on a 12-hr. strike last week. Two union miners, who were charged with intimidating and abusing a non-union miner, were discharged Feb. 10. A "committee" then called on Manager McLean and demanded the discharged men be reinstated. This, of course, was refused, whereupon every miner on shift walked out and formed a mob without the knowledge or consent of any union officials and closed down the mill and smeltery without giving a moment's notice. Nobody but the shiftbosses worked on the night shift of the 11th. Some of the more conservative heads must have finally prevailed, however, or perhaps the men bethought themselves of their Grievance Committee and that the case under consideration might come within the purview of that body, as everybody showed up for work at 7:30 on morning of the 12th. A conference was then had with the officials and everything was settled satisfactorily. The first monthly conference between the managers and the Grievance Committee will be held on the 21st. At that time it will be decided whether the men will get a flat raise in wages other than is due them by virtue of the sliding scale and the advance in the price of copper. Pending this meeting, a distinctly unsettled state prevails, but everybody seems to be very hopeful of an agreement being reached. A. V. Dye, secretary to Walter Douglas, who was instrumental in bringing about the vote of the union accepting the managers' offer to resume operations, is still on the job. Government investigators, Messrs. Davis and Myers, will remain at Clifton for a while, to oil the machinery, they say. The scale of wages under 24c. copper that went into effect when the mines resumed work is as follows:

	Before the Strike	After Strike
Mexican miners	$2.70	$3.41
Mexican timbermen	2.80	3.52
American timbermen	3.60	4.40
Carpenters	4.00	5.00
Machinists	4.25	5.31

TORONTO—Feb. 17

The Imposition of Taxes on Profits, by which it is expected to raise from $25,000,000 to $30,000,000 was announced Feb. 15 when Sir Thomas White, Canadian Finance minister, presented his annual financial statement. The tax is 25% on all net profits in excess of 7% of all incorporated companies having a capital of $50,000 or more; and 25% of all net profits in excess of 10% of individuals, firms and associations not incorporated with a capital of $50,000 or over. The minimum capital limitation does not apply in the case of companies or individuals having war orders. The taxation covers a period of three years beginning Aug. 3, 1914. Non-Canadian companies will pay pro rata on profits from Canadian business. The only businesses exempted are life insurance, farming and stock raising. Illuminating and lubricating oils are made dutiable at 0.5c. per gal.

The Mining News

ALASKA

GEORGE WILKINSON (Valdez) — Is to develop the Penochle group of claims adjoining the famous Ramsay Rutherford mine near Valdez glacier.

APEX MINING CO. (Valdez)—R. A. W. Krampitz, R. P. Ferguson and T. E. Dougherty, of Valdez, have filed articles of incorporation, with capital stock of $50,000.

OLD CHANNEL MINING CO.—Incorporated for $500,000. Principal office, Seattle, Wash. Incorporators: R. W. Martin and S. M. Gaylord, of Seattle, and William A. Gilmore, of Nome.

H. C. VANCE (Valdez)—Has been investigating many prospects in the Valdez field has let contract for a tunnel on the Bennett and Hines claims at Bettles Bay. Plans to erect a mill this summer.

ALASKA-BRITISH COLUMBIA MINES CO.—Incorporated at Olympia with capital stock of $1,000,000. J. F. McElroy, president; G. W. Allen, S. I. Silverman, J. D. Trenholme and J. C. Eden, incorporators.

COAL USED IN ALASKA, 1915—Coal imported into Alaska during 1915 amounted to 79,239 tons, valued at $397,290. This was a decrease of 13,862 tons from 1914. Some Alaska coal was mined in 1915, chiefly from the Cook Inlet field.

WRANGELL—Another new steamer to serve the Stikine River miners is being built at Seattle for Captain Sid Barrington, of the Side Streams Navigation Co. This will give the mines on the Stikine River much improved service during 1916.

ALASKA PEABODY (Valdez)—Reported that Captain Peabody has financed the Sulphide Gulch proposition and will shortly start shipping machinery to Valdez. This will open up a large copper property close to the Granby company's Midas mine. Name of operating company is the Alaska Peabody Copper Corporation.

ALASKA JUNEAU (Juneau)—Case involving water front and dockage facilities of the Alaska Juneau Gold Mining Co. and Worthen Lumber Mills that went to Court of Appeals at San Francisco on appeal of the Worthen company decided in favor of the Alaska Juneau company. Apparently all hindrances to wharves and millsite frontage removed. This will permit the Alaska Juneau to accomplish all plans in connection with water front improvements.

ARIZONA

Cochise County

COMBINED OUTPUT of the Calumet & Arizona and Copper Queen smelteries for the month of January was 20,000,000 lb.

HIGGINGS (Bisbee)—Formerly operated by Higgings Leasing Co., reverts now to owner, and will be operated under new management. J. J. Flannigan, formerly of C. & A. smeltery, at Douglas, will be manager, and Mike Ryan will be superintendent.

CALUMET & ARIZONA (Bisbee)—In 1915 produced 62,500,000 lb. of copper at 8c. Net earnings, $6,400,000, which breaks all its previous records. Dividends of $2,080,000 paid, leaving $4,300,000 to be added to surplus. Cost of 8c., which is a little higher than previous years, was caused by lowering of grade to get tonnage record.

Gila County

OLD DOMINION (Globe)—Is pumping 11,000,000 gal. of water daily at present.

Greenlee County

SHANNON COPPER (Clifton)—Concentrator was closed down two days last week for general repairs.

ARIZONA COPPER (Morenci)—Mines and mill are working full time, but are not yet up to full capacity.

DETROIT COPPER (Morenci)—Mines and mill are running at full time and are producing practically as much copper as before the strike last September. New storage-battery electric locomotive has been instaled on the fourth level, Ryerson. Motor is intended to pull dirt from the Colorado tunnel and also from 28, 30 and 31 stopes, Ryerson. If this innovation is a success, it will eliminate 4 mules and 8 mulemen. The water is below the 7th level in Old Yankee mine. This dries 1 stope and a main haulage road. Water is being lowered right along.

Mohave County

OATMAN COMBINATION (Oatman)—Has sold remaining treasury stock to San Francisco capitalists. Company owns property in heart of Oatman field; understood operations will now be on large scale.

GOLDEN STAR (Chloride)—Chas. R. Rutledge and associates, of Salt Lake City, who recently took over property, have begun unwatering 270-ft. incline by bailing. A 15-hp. gasoline hoist will be used.

Pinal County

U. S. SMELTING AND REFINING (Winkelman)—Has taken options on group of claims 1½ mi. southwest of Mammoth mine; is also negotiating for Mammoth-Collins and Mohawk properties in same district.

MAMMOTH (Winkelman)—Robt. O. Boykin and associates are operating old tailings dump for molybdenum and are shipping their concentrates to France and England. It is estimated that San Pedro River has washed away no less than 500,000 tons from old dump that averaged 1¾% molybdenum.

Santa Cruz County

WANDERING JEW (Patagonia)—Elgin B. and Walter E. Holt have purchased Wandering Jew from R. R. Richardson and Mark and Louis Lulley for $30,000. Men at work preparing to resume operations; lead-silver ore will be shipped to El Paso. Mine is in Santa Cruz mountains, 17 mi. northwest of Patagonia.

Yavapai County

WISHART PLACER (Zonia)—Has taken over Rebel group and will resume operations at once; has lain idle several years.

PITTSBURGH (Castle Rock)—C. E. Champie has shipped two carloads ore from this property, which he has recently started up. Development work has disclosed large tonnage of copper ore running higher than any Pittsburgh has previously produced.

GOLDEN EAGLE (Wickenburg)—New hoist being installed preparatory to sinking. Shaft sunk 200 ft. with whim. It is thought possible that mother lode of district lies on Golden Eagle: remains of old arastres are found all about property and ruins of old Spanish smeltery lie just west. Is in the Buckhorn district.

CALIFORNIA

Amador County

OLD EUREKA (Sutter Creek)—The mine has been sold or taken over upon an agreement of sale by Arthur Beam, of Denver, J. B. Mackie, Frank Swed, J. C. Gorrie and John B. Farrish, who form the board of directors. It is understood that the U. S. Steel Corporation is behind the deal and will take the property when exploration and development have reached a point to warrant the price, said to be $600,000. The mine has been owned for years by Hetty Green, of New York, and about once a year for several years past, when the time came for doing assessment work, it has been reported that the mine was sold. It is said that Mrs. Green has often complained that this was the only bad investment she ever made. She may now consider it not so bad an investment.

ALLEN (Ione)—Mine closed down for a week on account of breaking the hoist cable. A new cable was installed and work resumed at the 500 level. Construction of a spur track from the main line of the Amador Central R.R. to the mine is contemplated. This will permit more economic shipping of gold and copper ores.

Colusa County

VIETH (Mokelumne Hill)—Charles Pfeiffer, of Oakland, is opening up old tunnel on this placer ground. Property was originally worked by hydraulic methods, leaving a 100-ft. bank and from the face of this bank a 200-ft. drift was driven. The tunnel has been caved for some time. It is expected to strike the old Blue Lead channel.

QUICKSILVER MINING deals recently reported are denied by J. W. Cuthbert, of Williams. He states that he has sold no quicksilver claims and has no deal on at the present time. He is developing a discovery on his own land and expects to make it produce soon. Mr. Boggess is developing a quicksilver claim adjoining the Cuthbert and also has men at work on the Abbot mine, 3 mi. from Wilbur Spring.

Madera County

KROROMIC (Coarse Gold)—Properties formerly operated by Haggin & Hearst, comprising Texas Flat and Waterloo groups of gold mines. Increase in capital stock from $60,000 to $250,000 for purpose of opening three additional shafts and for modernizing present 20-stamp amalgamation and concentration mill. Texas Flat has about 30 ft. of low-grade gold ore and 2 to 7 ft. of high-grade.

Plumas County

MILL CREEK PLACER (Quincy)—J. G. Steel is extending a bedrock drift-tunnel to develop an ancient channel under Clearmont Hill. The property was worked in the early days by surface sluicing, but prospecting and development have shown that there is a large amount of coarse gold on bed rock.

Yolo County

REED (Rumsay)—Mineral rights of this quicksilver mine in Knoxville district have been purchased by Breed & Bancroft, of San Francisco and Oakland, according to deed filed for record at Woodland, made by F. L. Arbogast, of Oakland. Price said to be $5,000. Estimated that $60,000 will be expended in machinery and furnaces. The property includes Soda Springs, which have for several years been more profitable than the quicksilver mine. It was operated from 1875 to 1879, producing 5,650 flasks of quicksilver, and closed down when quicksilver was selling for $20 per flask. Little work has been done since. The present price of quicksilver has resulted in reopening property, which should be a profitable undertaking even with a reduction in the price to something nearer normal. It is reported that the Knoxville mine, 3 mi. southeast of the Reed, is producing about six flasks per month. This property is owned by F. E. Johnston, of Napa.

Yuba County

MARYSVILLE GOLD DREDGING (Marigold)—The hull of Marigold No. 5 all-steel 15-cu.ft. bucket-elevator dredge launched Feb. 16. Dredge is being constructed by Union Iron Works of San Francisco, and designed on the same general lines as Yuba No. 14, 16-cu.ft. dredge.

MANZANITA (Brownsville)—Property idle for several years will be reopened and developed on large scale by men from the East. The mine opened by a 300-ft. shaft and was equipped with a stamp mill, which was destroyed by fire. Other properties in Brownsville and Indiana Ranch districts are also preparing for development or operation.

COLORADO

Clear Creek County

SANTIAGO (Georgetown)—The Campbell Leasing Co. is advancing the 400-ft. level. An oreshoot 4 ft. wide and assaying $25 a ton has been opened.

McCLELLAN (Georgetown)—This property on Leavenworth Mt. is being developed by Laffey and Burkholder, who have recently struck a pocket of 600-oz. silver ore.

CAPITAL (Georgetown)—Holcombe, Harper & Co., lessees, are advancing the west heading on the Aetna vein. A shoot of payable milling ore has been opened having a width of 3.5 ft.

LAKE (Idaho Springs)—Recent development on this property, performed by the I. D. L. Leasing Co., has been highly encouraging. The main winze is being sunk to a depth of 165 ft. Two-thirds of the distance has been sunk in pay ore. G. K. Kimball is manager.

GAMBETTA (Georgetown)—A contract has been awarded to Oscar Wing to overhaul and repair the upper level, in which the company plans to resume development. A body of 30% zinc ore has been opened. T. W. Cunningham is manager.

FRENCH FLAG (Idaho Springs)—This Gilson Gulch property will be reopened and developed under the management of C. H. Ripley. Funds have ben provided for the work. Machinery is being overhauled and supplies have been ordered. The shaft will be unwatered down to the 200-ft. level.

IMPERIAL (Georgetown)—The Herber Leasing Co. is drifting on the Commonwealth vein. A streak of $100 ore has been opened. The Connors Leasing Co. is drifting on the Centennial vein. The vein has widened from 10 to 20 in. during the last 40 ft. of drifting and assays 55% lead and 20 oz. silver.

WYOMING VALLEY TUNNEL (Idaho Springs)—A contract to advance this tunnel another 100 ft. was awarded to Matt Kambell and the work is in progress. A crosscut will be driven to cut the Ardell vein, which is supposed to be the east extension of the Seaton vein. The tunnel will ultimately be driven to intersect the French Flag vein at a depth of about 650 ft. and will eventually drain this property.

Teller County

SOUTH BURNS (Cripple Creek)—On the eighth level of the South Burns shaft lessees Charles and Robert Brown have opened an oreshoot on the Shurtleff vein assaying from $20 to $30 a ton. On the 1,200-ft. level south of the shaft, lessees Fitzmorris and Quinn have opened an oreshoot on the extension of one of the veins of the Eagle system. The width of the vein is 2 ft. and the assay value is $60 a ton.

LAURA LEE GOLD MINING AND DEVELOPMENT CO. (Cripple Creek)—The new shaft house at the Laura Lee property on Mineral Hill has been completed. The shaft has been retimbered where necessary. A power line is under construction from the mine to the lines of the Arkansas Valley Railway, Light and Power Co. The company has purchased an electrically driven 5-drill air compressor and an electric hoist. Active underground development will begin as soon as the new equipment is in order. The shaft will be sunk to a depth of 550 ft. Al Pearce is superintendent.

IDAHO

Shoshone County

ADVANCE (Mullan)—Company will sell treasury stock to raise funds for development. Holdings include claims on Gentle Annie Gulch above Mullan, on which 1,600-ft. tunnel has been driven.

HYPOTHEEK (Kellogg)—Funds have been provided by underwriters to erect temporary mill of 150 tons' capacity at mine, to be moved to Enaville when sufficient ore has been developed to warrant larger concentrator. Recent strike of new vein on 1,100 level shows average of 2 ft. of clean galena and some milling ore.

STEWART (Kellogg)—It is reliably reported that this famous old mine will be closed down about Mar. 1, ore reserves having been entirely exhausted. Work on the adjoining Crown Point will continue and it is probable that leases will be let in main Stewart workings, as considerable ore is known to have been left behind.

WESTERN UNION (Wallace)—Articles of incorporation of Western Union Mining Co. were filed last week. Is outgrowth of consolidation of H. E. & M. Mining Co. and Aurora-Sampson Mining Co. in pursuance of an agreement entered into about two weeks ago. Two properties adjoin, on same vein, and are worked through same tunnel. Last summer first-named company erected a 100-ton concentrator and afterward found there was not enough ore to keep it going. In meantime second company encountered a fine body of galena, much of it of shipping grade. New company plans to begin shipping crude ore and start mill soon.

MICHIGAN

Copper

WINONA (Houghton)—Has not suffered in any particular by reason of storm. Its train service has been perfect and production exceeds previous records. Work of construction in new King Phillip shaft will be under way soon. Winona has advanced wages of employees to standard of all other mines in district.

CALUMET & HECLA (Calumet)—Storm which so much affected copper production in Lake Superior district in January brought out new use for steam shovel. Calumet & Hecla's enormous shovel was fitted with light-weight bucket six times regular size and was used to great advantage in clearing railroad yards of snow.

MOHAWK (Mohawk)—Output of refined copper in January 1,280,000 lb. This compares with December output of 1,413,038 lb. Extraction in December 21.42 lb. per ton and in January 22 lb. Mine was shut down eight shifts during January, owing to inability to transport rock to mill because of storms. February production likely will be larger than January, but no great increase can be expected for the same difficulties with storms already have curtailed production to slight extent.

Iron

HARD ORE (Ishpeming)—A new crushing plant is to be installed here. Two No. 5 Gates crushers will be added to the No. 8 now there. The work will be started immediately and the plant kept busy this year.

CLEVELAND-CLIFFS IRON CO. (Ishpeming)—The carrying capacity of the company's ore fleet has been increased by 1,500,000 tons per season by the addition of 10 boats recently purchased. This company has made large sales of ore for 1916 delivery, but will be able to get it all to lower lake ports with its fleet of 22 freighters. Close to 4,000,000 tons will probably be shipped this year.

CRYSTAL FALLS—Some of the Chicago & Northwestern Railway Co.'s new rolling stock has reached the Menominee range. Five hundred new ore cars were ordered last fall and deliveries are now being made. The cars will be used on the Menominee and Gogebic ranges, where there were shortages last summer, and are being distributed to the mining districts as rapidly as they are received. The Lake Superior & Ishpeming roads expect to get 400 new cars before Apr. 1.

MINNESOTA

Mesabi Range

HULL-RUST (Hibbing)—It is reported that 4,000,000 tons of ore will go forward from this property in 1916. In 1913 the mine shipped 3,457,608 tons. The total for 1915 was only 2,294,405 tons.

ALEXANDRIA (Chisholm)—The electric hoist and motors have arrived. Over 50 men are working underground. The orebody is rapidly being opened up. It will be possible to get out the first ore about the time shipping season opens. Several drifts and crosscuts are being run.

CHISHOLM—There will be over 1,500,000 tons of ore in stock in the Chisholm district when navigation opens. All of this will be moved this year. The Great Northern Ore properties will have 1,000,000 tons; the Shenango Furnace Co., 125,000 tons; the Oliver Iron Mining Co., 380,000 tons. Considerable ore will be hoisted and shipped during the time navigation is open. Much ore will also be taken from the pits, which are not operated during the winter months and have nothing in stock.

MISSOURI—KANSAS—OKLAHOMA

FRANK HARRINGTON AND ASSOCIATES (Joplin, Mo.)—Have developed one of richest strikes made recently in district, on their lease on Katherine land and Royalty Co.'s land, situated at Four Corners. Company will clean ore with hand jigs for present.

CHICAGO (Galena, Kan.)—Situated on Ellis land north of Galena; had shaft at mill completely washed away by Spring River changing its channel during recent heavy rains. Will sink new shaft on higher ground and remove and repair mill; work on both will be commenced as soon as weather permits. A. Royster is superintendent.

CORALBUT (Joplin, Mo.)—New lead and zinc concentrating plant will be ready to start within two weeks if favorable weather continues; the plant will have a capacity of 200 tons per 10 hr.; will use gas to furnish power to run both mill, compressor and steam hoist; cost about $20,000. Good run of zinc ore has been found at 140-ft. level of sheet ground formation. Lease is on John Jackson land at Chitwoody. R. A. Allen is superintendent.

MONTANA

Fergus County

BARNES KING (Kendall)—Returns on clean-up bullion for January from company's North Moccasin mine at Kendall and Piegan-Gloster at Marysville amounted to $53,078. Profits from mining and milling operations are estimated at $30,000 for both December and January. This would mean earnings at rate of $360,000 per year, or 90c. per share. Showing at company's Shannon mine in Marysville district is said to continue as good as ever, ore taken out averaging $27 in gold per ton. Company's lease on new properties in Rimini district, Lewis and Clark County, has been signed and development work will be started at once.

Lewis and Clark County

ANACONDA COPPER CO. (Rimini)—Is developing the old Porphyry Dike and Pauper's Dream properties under the management of Robert E. Cranston.

DAVIS-DALY CO. (Butte)—Company's report for quarter ended Dec. 31, 1915, shows that receipts were $73,092 and expenses $69,627, leaving a net profit of $3,465. During last quarter, company shipped 86 cars of ore averaging 7% copper and 7 oz. of silver per ton.

EAST BUTTE (Butte)—Company's profits from operations at Butte mines for month of December are given as nearly $100,000. During last three months, earnings have been somewhat reduced, due to a decided decrease in output from record figure which was reached in September, 1915, and amounted to 2,080,000 lb. of copper.

NEVADA

Lincoln County

PRINCE CONSOLIDATED (Pioche)—Recent directors' meeting, Salt Lake City, declared extra dividend of 2½c. per share, payable Mar. 1 to stockholders of record Feb. 24. Recent contract made with smelter calls for a minimum of 500 tons per day instead of 300 tons, as previously.

Nye County

TONOPAH ORE PRODUCTION for week ended Feb. 12 was 8,404 tons, valued at $177,432, compared with 8,445 tons for week previous. Producers were: Tonopah Belmont, 3,138 tons; Tonopah Extension, 1,800; Tonopah Mining, 1,750; Jim Butler, 750; West End, 640; Halifax, 53; miscellaneous leases, 374 tons.

TONOPAH EXTENSION (Tonopah)—It is stated that the company will add an additional 10 stamps to its present 40-stamp mill. Ore from the Victor shaft will be delivered to the mill by aërial tram.

HALIFAX-TONOPAH (Tonopah)—The winze on the 1,200-ft. level which was being sunk on the vein has been discontinued in favor of a three-compartment raise from east crosscut on 1,400-ft. level to connect with winze. Intermediate east drift from winze will be continued and is supplying present ore shipments.

Storey County

SIERRA NEVADA (Virginia)—Winze in 2,500 level No. 1 stope sunk on low-grade ore; north drift exposed vein matter of low assay.

ANDES (Virginia)—Saved 33 cars of ore from old stope on intermediate level.

HALE & NORCROSS (Virginia)—Lessees reopened tunnel level 12 ft. to the 718-ft. point.

MEXICAN (Virginia)—Shaft reopened by Comstock Pumping Association from 140-ft. point below the 2,000-ft. station to the 160-ft. point. Crosscuts in 2,500 and 2,700 levels advanced through porphyry and quartz of low assay. Mexican mill crushed 399 tons, averaging $19.10.

CROWN POINT-BELCHER (Gold Hill)—Installed No. 1 centrifugal sinking pump, which is in operation. Saved from No. 2 stope on 1,600 level, 83 tons of ore; north drift advanced 17 ft. Jacket mill received 407 tons mine ore and 30 tons dump rock; crushed for 3 days only. Shipped 370 tons from mine shaft to gloryhole.

NEW JERSEY

AMERICAN SMELTING AND REFINING CO. (Perth Amboy)—Contrary to reports in the daily press, tin smelting has not yet started at this works.

NEW MEXICO

Dona Ana County

BOYD MINES (Las Cruces)—Work cleaning up main tunnel on property in South Andres Cañon is progressing and two stations in the main shaft are being cut. Considerable copper-lead ore has been uncovered. Engineer has recently examined different properties of Mr. Boyd in this locality and development of large bodies of ore will soon begin.

Santa Fe County

VALUE OF OUTPUT OF MINES in New Mexico for 1915 was approximately $10,000,000, according to tax commissioners.

Sierra County

LAS ANIMAS PEAK GOLD (Hillsboro)—Company has bought Senator Andrews property and is sinking new shaft in country rock. Veins will be cut with laterals.

EL ORO (Hillsboro)—Company, which has been in hands of receiver for some time, has been sold to Eastern capitalists by promotion of Mrs. J. P. Conners. Workings are being unwatered; said to be rich in gold.

SOUTH DAKOTA

Lawrence County

BUFFALO (Deadwood)—This property, at head of Two Bit gulch, is being developed by P. N. Hanson and associates.

CUTTING (Deadwood)—Plans are maturing for commencement of extensive exploration of this property on Deadwood gulch, formerly known as Gladiator.

WASP NO. 2 (Flatiron)—Production of wolframite continues at satisfactory rate. First consignment of concentrates will soon be marketed.

HIDDEN TREASURE (Deadwood)—Sinking has been resumed below the 200 level. Gasoline driven hoist and air compressor are being used in the work.

HEIDELBERG (Deadwood)—Ore has been encountered in new territory in north crosscut at point 170 ft. from main tunnel. Assays of $20 per ton, in gold, have been received from new find.

RATTLESNAKE JACK (Deadwood)—Considered installing plain filter for thickening tailings, but instead constructed a retaining dam. Now operating very successfully without use of filter of any kind, except Merrill for precipitation. Plant is very satisfactory.

UTAH

Beaver County

SOUTH UTAH (Newhouse)—Reported that a satisfactory saving is being made on tailings by the Utah Leasing Co. using an oil-flotation process. This ore runs 14 lb. copper to the ton.

GOLD HILL (Beaver City)—A new strike reported at this property in Newton district, 5 mi. east of Fortuna. Assays running well in gold were obtained across 5-ft. vein. This property adjoins the Sheep Rock and is controlled by Salt Lake men.

Juab County

TINTIC SHIPMENTS for the week ended Feb. 11 amounted to 123 cars, as compared with 76 the week preceding.

SCRANTON (Eureka)—Four men are being worked at this property by Wade and Tibby, Salt Lake engineers, who have the property under lease. The ore is lead and zinc.

UTAH MINERALS CONCENTRATING (Eureka)—Capacity of the mill has been increased by changes in equipment. It is expected to treat 250 tons daily of May Day dump ore. Hauling charges from May Day will be about 28c. per ton.

OPOHONGO (Mammoth)—It is reported that work under lease will be started by the Gold Chain Co. above the tunnel level in the Missing Link claim. Drifting will be begun in Opohongo ground, and the work extended into the Gold Chain. This will make the third lease operating at the Opohongo.

IRON BLOSSOM (Silver City)—Several cars of ore have been shipped from the new find of copper ore on the 1,000 level where stoping is being done. The body is apparently growing larger with depth, and sinking will be done through a winze before much lateral development is undertaken. Shipments for the week ended Feb. 11 amounted to 22 cars.

Salt Lake County

THE UTAH COPPER'S NET RECEIPTS FOR 1915, as shown in the statement filed Feb. 7, with the state board of equalization, are $13,741,480, as compared with $4,538,000 in 1914. The gross receipts are shown to have been $27,115,943 and the costs $13,414,463. The production was 36,760 fine oz. gold; 413,912 fine oz. silver; 156,207,376 lb. copper. The total tonnage of ore handled amounted to 8,494,300 tons. The report for the quarter ended Dec. 31, 1915, shows that 44,224,715 lb. copper were produced as compared with 44,766,841 lb. for the quarter preceding. The total net profits amounted to $6,919,203, as compared with $4,414,564. Dividends amounting to $2,436,735 were paid, leaving $4,482,466 carried to surplus. Earnings in this quarter were based on an average price of 21.408c. per lb. copper; average costs per pound was 6.10c., after allowing for smelter deductions and crediting miscellaneous income. Cost of copper in previous quarter was 6.72c. and price received, 16.252c.

Summit County

PARK CITY SHIPMENTS for the week ended Feb. 11 amounted to 1,075 tons, the shippers being Silver King Coalition, Daly-Judge, Daly West, Silver King Consolidated, Ontario and Naildriver.

AMERICAN FLAG (Park City)—Arrangements are being made to resume operations at this property.

ONTARIO (Park City)—Pumping has been started on the 1,700 level in ground which was under water for 12 years.

NEW QUINCY (Park City)—Raising is being done for the limestone bedding productive in the adjoining Daly-Judge and Daly West.

VIRGINIA

Nelson County

ALBEMARLE ZINC AND LEAD (Faber)—Martin & Co., Philadelphia, has purchased bonds of company and will inaugurate exploration and development campaign. New roads and houses being constructed. Old mill will be remodeled.

WASHINGTON

Stevens County

UNITED COPPER (Chewelah)—Negotiations for control are pending. Announced at annual stockholders' meeting in Spokane recently that directors had given option on property and that large majority of stock had been pooled under agreement to sell at $1 per share; 90-day option given requiring delivery of at least 75% of outstanding stock of 1,000,000 shares.

WISCONSIN

Zinc-Lead District

HUMP (Montfort)—Levi Pollard and associates, operating O. P. David mine, have leased the Nagle property at Montfort.

SENATOR (Mifflin)—Henry Cochems and other Milwaukee men have taken over mine and mill and have commenced operations on Bainbridge land.

FRONTIER (Galena, Ill.)—Contract has been given for 200-ton mill on Hird lease at Benton. New Treganza mill at Benton has been placed in operation.

VINEGAR HILL ZINC (Platteville)—New 200-ton Blackstone mill has been completed and operations begun at New Diggings adjoining Champion property.

K. C. & M. (Platteville)—Has started milling at the Wilkinson, Benton, where surface equipment of the Vinegar Hill Zinc Co. was destroyed by fire last summer.

CANADA

British Columbia

STANDARD SILVER-LEAD (Silverton)—Gross earnings for December, $136,771; net profit, $100.545. Paid in dividends that month, $100,000. Shipments of silver-lead ore and concentrates in December, 1,049 tons. Tonnage of zinc production for month is not given.

Ontario

ORE SHIPMENTS OVER THE T. & N. O. RY. in January, 1916, from Cobalt proper: Beaver, 57 tons; Buffalo, 93; Cobalt Comet, 44; Coniagas, 60; Crown-Reserve, 65; Kerr Lake, 66; La Rose, 135; McKinley Darragh, 76; Cobalt Lake, 85; Townsite City, 35; Nipissing, 196; Penn Canadian, 90; Peterson Lake, 115; Temiskaming, 63; from New Liskeard, Casey Cobalt, 40; total silver-ore shipments, 1,228. From Schumacher, McIntyre (gold), 3; from Porquois Jct., Alexo Mine (nickel), 1,227; from Latchford, Roud Syndicate (copper), 24 tons.

PORPHYRY HILL (Porcupine)—Has been purchased by Northrups of Chicago.

SWEET (Porcupine)—Properties in Robb Township have been optioned.

DAVIDSON (Porcupine)—Has been optioned to interests associated with Seneca Superior.

JAMIESON (Porcupine)—Properties in Robb Township have been optioned to Toronto men for $105,000.

KERR LAKE MAJESTIC (Cobalt)—This property was sold at bailiff's sale on Feb. 15 to William Donnell, of Ottawa, for $5,000.

DOME EXTENSION (Porcupine)—The underground workings are now completely unwatered and development will be started immediately. The present working shaft will be put down to the 500-ft. level.

Quebec

ASBESTOS CORPORATION OF CANADA—The financial statement for 1915 showed profits of $386,377, an increase of $43,141 over the previous year, of which $93,594 was added to the surplus, bringing the total up to $284,626.

Yukon Territory

CANADIAN-KLONDYKE (Dawson)—Output for three days ended Jan. 25 was 324 oz. All dredges now closed down for season.

MEXICO

Sonora

CANANEA CON. (Cananea)—Eight furnaces being operated; about 3,200 men are employed. January production was approximately 4,000,000 lb.; district quiet politically.

The Market Report

Metal Markets

NEW YORK—Feb. 23

The markets for the principal metals were rather dull during the last week. Lead and tin were the strongest and most interesting features.

We have received several letters from traders in copper complaining that our quotations for copper last week were too low. We quoted, as always, the major market, that is, the sale of the bulk of the copper as done by producers and agencies. In the existing conditions prompt and near-by copper in the hands of dealers and speculators is commanding a premium—a little while ago sales of such could at times be made only at a discount—but transactions in such are relatively trifing and do not reflect the major market, that is, what the producers are getting for the bulk of their output.

Copper, Tin, Lead and Zinc

Copper—Conditions in this market remained substantially unchanged from the previous week, but there was decidedly less business done. France is no longer the urgent buyer that she was a little while ago. The price of the principal producers continues to be 27¼c., r.t., and some sales of million-pound and half-million-pound lots were made to domestic consumers during the week, and on Wednesday at that price. Belated buyers who had to have prompt copper still had to pay premiums, but while such business all along has been relatively trifling, there was less of it last week than in the previous week and holders of prompt copper were hunting buyers rather than the opposite. On the other hand, there was exhibited a certain tendency among second-hands to dispose of copper for later deliveries at a concession from prices previously ruling, but this was believed to reflect a dullness of demand rather than any incipient trend of the market.

Copper Sheets have again advanced and are now quoted at 35c. per lb. for hot rolled and 36c. for cold rolled. Copper wire is quoted at 29¼@29¾c. per lb. for large lots at mill. The demand for wire is reported very good.

Copper Exports from Baltimore for the past week included 448,399 lb. bars to Gothenburg, Sweden, and 10,236,980 lb. bars, plates and ingots to Havre, France.

Visible Stocks of Copper in Europe Nov. 15: Great Britain, 7,387; France, 1,390; afloat from Chile 2,250; afloat from Australia, 4,300; total 15,327 gross tons, or 34,332,480 lb. This is a decrease of 2,196 tons from the Feb. 1 report.

Tin—Business was rather good, and from all appearances demand is thought likely to keep up with undiminished strength.

The United States Navy Department has made considerable purchases of tin for its current needs, at prices not stated. It is understood that the buying includes some Straits and some Chinese tin.

The demand for tin plates appears to be very strong; prices have advanced, and a good deal of tin is being taken by the tin plate makers. For the first time, tin plates in considerable quantities are being shipped to Europe.

Lead—A large business was done again during the last week, chiefly by the leading interest. Most of the independent producers are sold out to such an extent that they are unable to supply any more lead for prompt shipment. Efforts are being made by the producers to take care of domestic consumers, and especially their regular customers, rather than to accept orders for export, and for this reason several overtures with regard to foreign business were rejected. The position of the independent producers is reflected by the St. Louis market, where the price advanced a little further, while the New York price remained stationary.

Spelter—Business was relatively light during the last week. On Feb. 17 a few sales for export were made, but since then this business has been diminishing, and speaking generally Europe is no longer a buyer. There was some reselling of February spelter previously contracted for, but this did not release sufficient to affect materially the price obtainable for spelter for prompt delivery. Prompt and March spelter continued to command upward of 20c., but spelter for April-June delivery became considerably easier.

Imports at Baltimore for the week included 2,000 tons of zinc concentrates from Melbourne, Australia.

Zinc Sheets are in steady demand. Cold weather and storms have interfered with shipments and deliveries. Prices have been advanced and are now $25 per 100 lb., f.o.b., Peru, Ill., less 8% discount.

DAILY PRICES OF METALS IN NEW YORK

Feb.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	St. Louis, Cts. per Lb.
17	4.7600	56⅝	26¾ @27¼	42⅛	6.30	6.17½ @6.22½	18.00 @20.50
18	4.7600	56⅝	26¾ @27¼	42⅛	6.30	6.17½ @6.22½	18.00 @20.50
19	4.7625	56⅝	26¾ @27¼	42⅛	6.30	6.17½ @6.22½	17.50 @20.50
21	4.7650	56¾	26¾ @27¼	42¼	6.30	6.20 @6.22½	17.25 @20.25
22	.....	..	....	..	....	....	....
23	4.7650	57	26¾ @27¼	42⅛	6.30	6.20 @6.25	17.25 @20.25

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Feb.	Silver	Copper				Tin		Lead		Zinc	
		Standard		Electrolytic							
		Spot	3 Mos.	£ per Ton	Cts. per Lb.	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
17	26⅞	106¼	103¼	136½	33.31	181	181	32	6.81	102	21.71
18	26⅞	108	106	137½	33.53	180	180	32	6.81	103	21.92
19	26⅞	.....	.....	.....	.....	.....	.....	.....	.....	....	....
21	26 15/16	108	105¾	136	33.21	180½	180¼	32	6.82	103	21.93
22	27	107	104½	136	33.21	180	180½	32	6.82	105	22.36
23	27 1/16	106½	104¾	136	33.21	181½	181½	32½	6.87	105	22.36

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½c.

Other Metals

NEW YORK—Feb. 23

Aluminum—Demand is good and supplies are not so plentiful as they might be. Prices are again firmer and sales are made at 58@60c. per lb. for No. 1 ingots for early delivery.

Antimony—The arrivals reported last week did not come on the general market at all, but were absorbed by contract deliveries, as was anticipated. Demand has been fairly good and stocks are small, so that prices have again stiffened a little. Chinese and American brands are quoted at 44@45c. per lb. for early deliveries. Cookson's is scarce still and is held at 57@60c. per lb., New York.

Quicksilver—The market has been rather more quiet but firm. Stocks remain low. It is reported that an attempt has been made to secure some metal abroad, but it was barred by a refusal to grant licenses for export. New York price remains $285@300 per flask of 75 lb. for large lots; $295@300 for smaller orders. San Francisco reports by telegraph $285@300 per flask, with small sales. London price has been advanced to £19 per flask.

Quicksilver Receipts at San Francisco were approximately the same in 1915 as 1914, being 4,392 and 4,372 flasks respectively. The receipts in January, 1916, were 358 flasks; the receipts in 1915 and 1914 by the month were as follows: January, 1915 and 1914, respectively, were 522 flasks and 292 flasks; February, 407 and 311; March, 446 and 330; April, 358 and 563; May, 272 and 157; June, 452 and 430; July, 448 and 436; August, 205 and 237; September, 412 and 314; August, 264 and 399; November, 245 and 456; December, 360 and 449.

Nickel—The market is steady, with domestic demand about as usual and some good inquiries for export. Quotations are unchanged at 45@50c. per lb. for ordinary forms, according to size and terms of order. For electrolytic metal 5c. per lb. more is charged.

The correspondence between the Canadian Government and the International Nickel Co. in relation to a refining plant in Canada has been published. The company agrees, as has been already stated, to establish such a refining plant in Canada to treat at least enough of its nickel matte to supply the demand for Canada and Great Britain. The plant will probably be on the seaboard.

Minor Metals—Current quotations for Bismuth are $4 per lb., New York.—**Cadmium** is quoted at 7s. per lb. in London; $1.50 per lb., New York.—**Chromium metal,** 75c. per lb., New York.—**Cobalt metal,** 97% pure, is sold at $1.25@1.50 per lb.—**Magnesium,** pure, remains at a high price, $6 per lb. being asked.—**Selenium** varies from $2.50@3 per lb., New York, for large lots; $4.50@5 for retail quantities.

Gold, Silver and Platinum

NEW YORK—FEB. 23

Gold—Some more exports of gold from New York are reported, chiefly on Dutch account. There have also been some gold shipments to Argentina.

Platinum—Market conditions are not materially changed. Supplies are small and sales irregular. Dealers will not quote prices and transactions of any importance are settled by negotiation. Sales are reported still at $85@95 per oz. for refined pratinum.

Our Russian correspondent writes under date of Jan. 15 that a government order has been issued prohibiting all holders of platinum—banks, mining companies, individual miners, dealers, jewellers, etc.—from selling or alienating in any way the metal which they hold. The entire stock of platinum in Russia will be requisitioned by the government; but the price at which it will be taken is not yet announced.

This order stops all business. The last sales of crude metal, 83% platinum, before the issue of the order were at 16@16.20 rubles per zolotnik at Ekaterinburg; 64,000@65,000 rubles per pood at St. Petersburg—equal to $60.54 and $63.21 per oz., averages.

Silver has advanced to 27 1/16d. in London, owing to the broadening of the orders there, the reduction of the London stock and and the absence of shipments to London in early February from New York. No boats are sailing under the American flag Saturday, Feb. 12, from New York.

Stocks of silver at Bombay have been reduced from 6,700 bars in December to 4,500 bars last week. Stocks in Shanghai last week are reported at 584 bars and 50,500,000 oz. sycee, a considerable decrease. The reduction at Bombay is due to a large purchase for coinage by an important Native State.

Zinc and Lead Ore Markets

JOPLIN, MO.—Feb. 19

Blende, high price $131.70; base price per ton 60% zinc, premium ore, $130; medium grades, $125@115; and lower grades down to $110; calamine, per ton 40% zinc, $90@80; average selling price, all grades of zinc, $117.82 per ton. Lead, high price, $88; base per ton 80% metal content, $86@88; average selling price, all grades of lead, $85.88 per ton.

	Blende	Calamine	Lead	Values
Totals this week..	16,829,530	1,290,150	2,265,400	$1,164,740
Totals this year...	92,636,600	8,172,770	14,202,250	6,025,940

Blend value, the week, $1,019,960; 7 weeks, $5,165,660.

Calamine value, the week, $47,510; 7 weeks, $293,980.

Lead value, the week, $97,270; 7 weeks, $566,300.

With a week of clear weather, with no rain or snow, the dewatering of the most important mines has progressed far enough to enable a resumption of operations. Outlying mines dependent upon coal fuel are beginning to resume operations. The latter are still handicapped by soft roads preventing the hauling of fuel. The outlook tonight is, however, that even with freezing and thawing alternate temperatures active operations may be resumed at all mines by the end of another week, or by Mar. 1 at most. While the production has been kept down from various causes, buyers have been loading from accumulated stocks until the reserve stock is quite obliterated.

PLATTEVILLE, WIS.—Feb. 19

The base price paid this week for 60% zinc ore was $122@125 per ton. The base price paid for 80% lead ore was $80 per ton.

SHIPMENTS WEEK ENDED FEB. 19

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	4,394,000	80,000	1,284,160
Year	27,976,000	495,700	5,989,460

Shipped during week to separating plants, 6,770,000 lb. zinc ore.

Iron Trade Review

NEW YORK—Feb. 23

Chief developments of the past week have been the placing of heavy export orders, which had been foreshadowed but are now definitely closed.

Domestic business has been lighter, buyers holding back on account of uncertainty as to deliveries. Mills cannot promise early filling of orders under present conditions. The higher prices also are discouraging some domestic contracts. The flood of export orders, however, is the main drawback.

Storms and very cold weather have again cut down production a little, while railroad delays are again troublesome.

The pig-iron market is more active and some heavy buying of basic iron is reported. Foundry iron is also in better demand and buyers are inclined to make commitments further ahead than they were. There are some indications that another buying movement in pig iron is beginning.

The syndicate which took options on the stocks of the Thomas Iron Co. and the Empire Steel and Iron Co. failed to exercise those options, which have now expired. The syndicate, however, exercised its option on the stock of the Wharton Steel Co.; but it is understood that the title has not yet passed. The proposed consolidation has fallen through.

The sale of the Pennsylvania Steel Co. to the Bethlehem is referred to on another page.

Exports and Imports of Iron and Steel in the United States, so far as they are reported by tonnage, were as follows for the year ended Dec. 31, in gross tons:

	1914	1915	Changes
Exports	1,549,533	3,532,347	I. 1,981,814
Imports	289,125	282,441	D. 6,684

The heavier items of export in 1915 were billets, ingots and blooms; wire; bars; sheets and plates, and rails. The value of all iron and steel trade, including machinery, is given as follows:

	1914	1915	Changes
Exports	$199,861,684	$388,852,642	I. $188,990,958
Imports	28,642,862	20,380,093	D. 8,262,769
Excess, exports....	$171,218,822	$368,472,549	I. $197,253,727

The larger imports were of scrap iron and steel and of ingots, billets and blooms.

PITTSBURGH—Feb. 22

The sharpest steel price advance in this movement was made late last week, when the Carnegie Steel Co. made an advance of $5 a ton in certain products, putting bars and shapes at 2.25c., plates at 2.35c. and hoops at 2.50c. Until Nov. 4, 1915, the advances in bars, plates and shapes were $1 a ton in each instance, while on that date an advance of $2 was made. Instead of the advance in steel prices tapering off, it is proceeding with greater vigor, and in some conservative quarters it is predicted that bars, plates and shapes will be 3c. before long.

The present advance is not so radical as might be thought, because the large mills, which have but one price, and make such deliveries as they can, have been booking business in a very reserved manner, while the smaller mills, which accept premiums on early deliveries, have been securing premium prices for later and later delivery, and thus the delivery periods of the two classes of mills are tending to connect.

It has been recognized all along that the steel market was likely to break, or at least experience a great decline, whenever the war should end, and despite the sharp advances now occurring the producers do not admit any likelihood of a decline before that time. While the carrying out of many projects is doubtless being deferred there is still demand for more steel than can be furnished and the export demand for neutral countries has hardly been touched.

It is impossible to estimate with any closeness the time for which the mills are sold up, for in addition to specific orders and regular contracts the mills have made various promises to take care of customers for such tonnage as can be furnished. Even the specifications on books cannot be taken without allowances, for doubtless many buyers have made up conventional specifications, expecting to change them later. Present circumstances all indicate that the mills will be called upon to work at capacity through this year.

Labor and transportation conditions promise serious difficulties. Some mills are already paying premium rates on some of their labor and when outdoor operations are resumed on a larger scale an acute shortage of labor is likely.

Tinplate is quotable at $4 a box for 100-lb. cokes, against $3.75 lately quotable and $3.60, the so-called "season price" at which the large contracts were made late in the old year. Tinplate is scarce for early delivery, at a time of year when consumption is relatively light. It appears tha many buyers have been accumulating stocks, fearing a shortage later.

Pig Iron—It is possible that another general buying movement in pig iron has started, after two months of virtual stagnation. The Portsmouth Steel Co. has bought 30,000 or 40,000 tons of basic and the American Rolling Mill Co. 25,000 tons, while the Kokomo Steel & Wire Co. is just closing for 40,000 tons. This iron comes from Southern Ohio, Columbus and lake front furnaces. The Youngstown Sheet & Tube Co. has bought 20,000 tons of Valley bessemer, in several parcels, at about $20, Valley furnaces. While this is 50c. under the market lately quoted and $1 under the market at the beginning of January, bessemer had advanced to $3 above basic, an utterly abnormal spread, due to fears of a bessemer ore shortage before the opening of lake navigation. We quote: Bessemer, $20; basic, $17,75@18; malleable and forge, $18@18.50; foundry, $18.50, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Steel—The turnover in billets and sheet bars is still light, mills having little if any steel to sell while the average consumer could not afford to pay prices that would be asked, and must be content with such deliveries as are made on contracts, at materially lower prices than would be asked in the open market. We quote $35 for bessemer and $38 for openhearth billets and sheet bars as representing possible settling prices in case business were done. Rods are $50, with occasional sales being made at the figure.

FERROALLOYS

Ferrosilicon of high grade is in demand still. The nominal quotation for 80% alloy is $85 per ton, Pittsburgh, but up to $95 is reported paid for lots for early delivery. Future deliveries are a little lower and $84 per ton is quoted on contracts covering first half delivery.

Spiegeleisen is firm and higher. Sales of 20% alloy are made at $40@45 per ton Pittsburgh.

Ferromanganese—The acute scarcity of ferromanganese continues, and prompt material can hardly be found at $225, quotations of $250 being common. English on contract remains nominally at $125, Baltimore, but the delivery would be far in the future.

Imports at Baltimore for the week included 3,647 tons ferromanganese from Great Britain.

FOREIGN IRON

Shipments of pig iron from Middlesbrough, England, years ended Dec. 31, in long tons:

	1913	1914	1915
Coastwise	509,042	426,392	45,525
Foreign	737,842	500,946	383,202
Total	1,246,884	927,338	428,727

Shipments to France and Italy increased last year. To all other countries there was a decrease, those to Belgium and Germany being cut off altogether.

IRON ORE

There are reports of higher rates paid for Lake tonnage by ore shippers who have not yet covered their boat requirements for the season.

Some sales of Lake ore to Eastern furnaces are reported.

Imports of iron ore in the United States 12 months ended Dec. 31 were 1,350,588 gross tons in 1914, and 1,341,281 tons in 1915; a decrease of 9,307 tons last year. The larger items of imports were 815,017 tons from Cuba; 280,887 from Sweden; 66,982 from Spain and 52,514 tons from Canada.

The Beach Glen Iron Mining Co., of Dover, N. J., with capitalization of $250,000, has been incorporated by Benj. Nicoll, New York; Cortlandt Nicoll and Wm. H. Tonking, Dover. The company has taken over the Beach Glen mine, near Rockaway, N. J., which has not been operated for several years. The Beach Glen ore is a magnetite, low in phosphorus.

The Great Lakes Transit Co., which has been organized at Buffalo to take over the steamships heretofore owned and operated by the railroad companies, will not touch the iron ore business. The steamers taken are carriers of general freight and grain and do not include any in the iron ore or coal trades.

OTHER ORES

Antimony Ore is in some demand and sales have been made of moderate lots at $2.25@2.50 per unit.—**Molybdenite,** 85 to 90% MoS_2, is quoted at $1.40@1.45 per unit, with a moderate demand.—**Tungsten Ore** is in very strong demand. The high prices have apparently failed to bring out new supplies. As high as $70 per unit has been paid for February and March delivery.

COKE

Coke production in the Connellsville region for the week is reported by the "Courier" at 441,306 short tons; shipments, 432,456 tons. Shipments of Greensburg and upper Connellsville districts, 48,206 tons.

Connellsville—Car supply was very poor last week and coke became very scarce, with rumors that $4 was paid for small lots of spot on Saturday. The furnaces could probably use more coke than they are receiving under contract, but are indisposed to pay fancy prices to eke out. There is considerable inquiry for smelter coke for export over the next few weeks. Car supply this week has been fair and with continued good weather may improve further. Quotations are largely nominal, as follows: Prompt furnace, $3.50@3.75; contract, first half, $2.35@2.50; year, $2.25@2.35; prompt foundry, $3.75@4.25; contract, $3.25@3.75, per net ton at ovens. Reports are that construction work on byproduct plants that were expected to reduce the requirements in beehive coke very materially in the early months of this year is proceeding very slowly.

Chemicals

NEW YORK—Feb. 23

The general trade is in fair shape and the markets show a firm tone.

Arsenic—Consuming demand appears to be good and inquiries are frequent. Quotations are $5.25 per 100 lb. for carloads and over, and $5.50 per 100 lb. for smaller lots.

Copper Sulphate—There is a fair inquiry, both for domestic delivery and for export. Quotations are unchanged at about $22 per 100 lb. for carload lots and $22.25 per 100 lb. for smaller orders.

Nitrate of Soda—Sales are kept up by the heavy demand from makers of explosives. Fertilizer buying is about as usual. Prices are again higher, $3.90 per 100 lb. being named for spot and up to June. For futures after June $3.60 per 100 lb. is named.

Sulphate of Ammonia—The British government has suspended for a time all licenses for export of sulphate, which has unsettled the market.

PETROLEUM

Exports of petroleum from Mexico to the United States in January were: From Tampico, 1,315,977 bbl.; from Tuxpam, 550,505 bbl.; total, 1,866,482 bbl.; a large increase over January of last year.

Assessments

Company	Delinq.	Sale	Amt.
Adventure, Mich	Mar. 20	.....	$0.50
Adventure, Mich	July 20	.....	0.50
Alta-Germania, Utah	Feb. 8	Feb. 28	0.005
Alta Tunnel, Utah	Feb. 15	Mar. 4	0.01
Basalt, Nev	Mar. 8	Apr. 6	0.003
Belmont, Ida	Feb. 15	Mar. 11	0.003
Boston Development	Feb. 17	Mar. 8	0.05
Cash Boy, Nev	Feb. 16	Mar. 20	0.01
Columbia Ex., Utah	Feb. 23	Mar. 14	0.025
Emerald, Utah	Feb. 15	Mar. 11	0.00½
Emerald, Utah	Mar. 15	Apr. 11	0.00½
Empire M. & D., Ida., (post.)	.....	Mar. 10	0.005
Exchequer G. & S., Nev	Feb. 16	Mar. 8	0.03
Federal Ely, Nev	Mar. 1	Apr. 3	0.005
Federal Ely, Nev	Apr. 1	May 1	0.005
Federal Ely, Nev	May 1	June 4	0.005
Four Timbers, Ida	Feb. 24	Mar. 24	0.002
Great Copper King, Utah	Feb. 14	Mar. 11	0.001
Imperial, Ida	Feb. 19	Mar. 20	0.003
Index, Ida	Feb. 6	Mar. 6	0.0025
Jacket-Crown Pt.-Belc., Nev	Feb. 18	Mar. 10	0.06
Laclede, Ida	Feb. 4	Feb. 28	0.003
Lucky Deposit, Utah	Feb. 11	Mar. 13	0.005
Monarch Pitts., Nev	Feb. 18	Mar. 20	0.01
Nevada-Douglas, Nev	Feb. 10	Mar. 10	0.10
New Quincy, Utah	Mar. 11	Mar. 30	0.01
Park Gold, Utah	Apr. 1	Apr. 20	0.001
Queen Bess, Utah	Feb. 20	Mar. 20	0.005
Revenue Cons., Utah	Feb. 5	Mar. 3	0.01
Rio Grande Grubstake, Utah	Dec. 25	Feb. 29	0.006
Rob Roy, Ida	Feb. 5	Mar. 5	0.002
Sandstorm Kendall, Nev	Feb. 21	Mar. 27	0.01
Santaquin King, Utah	Feb. 8	Mar. 8	0.00125
Scorpion, Nev	Feb. 21	Mar. 14	0.01
Silver Moon, Ida	Feb. 26	Mar. 22	0.005
Silver Mountain, Ida	Feb. 17	Mar. 17	0.002
Silver Pick Con., Nev	Feb. 28	Apr. 3	0.01
Slavonian, Ida	Feb. 1	Feb. 29	0.001
Snowshoe, Ida	Feb. 15	Mar. 15	0.005
Summit Ex., Utah	Mar. 15	May 1	0.01
Tar Baby, Utah	Dec. 31	Feb. 28	0.005
Tintic Milling, Utah	Mar. 14	Apr. 3	0.03
Tintic Standard, Utah	Mar. 15	Apr. 10	0.005
Tyler M. & M., Ida	Jan. 28	Feb. 28	0.001
Utah-United, Utah	Mar. 10	Mar. 30	0.01
Uvada, Nev	Feb. 21	Mar. 20	0.02
West Toledo, Utah	Mar. 6	.....	0.01

Stock Quotations

COLO. SPRINGS Feb. 21		SALT LAKE Feb. 21	
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.05	Beck Tunnel	.17½
Cripple Cr'k Con	.008	Black Jack	.13
Dante	.04	Colorado Mining	.22½
Doctor Jack Pot	.11½	Crown Point	.06
Elkton Con	.34½	Daly-Judge	8.35
El Paso	.80	Emma Cop	.63
Findlay	.04¾	Gold Chain	‡.12½
Gold Dollar	.03	Grand Central	.65
Gold Sovereign	.04½	Iron Blossom	1.65
Golden Cycle	2.12	Lower Mammoth	.06½
Isabella	.22½	May Day	.19
Jack Pot	.07	Opohongo	.01½
Jerry Johnson	.06¾	Prince Con	1.17½
Lexington	‡.004	Seven Troughs	.13½
Mary McKinney	.47	Silver King Coal'n	3.42
Pharmacist	‡.01¾	Silver King Con	2.40
Portland	1.75	Sioux Con	.10
Raven B. H.	.02½	Uncle Sam	.09¼
Vindicator	1.28½	Yankee	.30

SAN FRANCISCO Feb. 21			
Alta	.05	Belmont	4.35
Andes	.05	Jim Butler	.95
Best & Belcher	.03	Lone Star	.03
Caledonia	.27	MacNamara	.04
Challenge Con	‡.05	Midway	.15
Chollar	‡.02	Mont.-Tonopah	.25
Confidence	.15	North Star	.15
Con. Virginia	.07	Rescue Eula	.06
Gould & Curry	.01	West End Con	.73
Hale & Norcross	.03	Atlanta	.19
Jacket-Cr. Pt.	.13	Blue Bell	.02
Julia	‡.01	Booth	.39
Mexican	.16	C.O.D. Con	.03
Occidental	.75	Comb. Frac	.07
Ophir	.17	D'field Daisy	.04
Overman	.05	Jumbo Extension	1.12½
Savage	‡.04	Pitts.-Silver Peak	.08
Seg Belcher	.03	Round Mountain	.56
Sierra Nevada	.19	Sandstorm Kendall	.04
Union Con	.43	Silver Pick	.03
Utah Con	.02	Central Eureka	.11

TORONTO Feb. 21			
Bailey	.05½	Dome Exten	.28½
Chambers Ferland	.23½	Dome Lake	.24½
Coniagas	4.12½	Foley O'Brien	.51
La Rose	.63	Hollinger	25.00
Peterson Lake	.24½	Imperial	.03½
Right of Way	.05½	Jupiter	.21½
Seneca Superior	.56	McIntyre	.92½
T. & Hudson Bay	25.00	Porcu. Crown	‡.80
Temiskaming	.55½	Preston E. D.	.03½
Trethewey	‡.16	Vipond	.68½
Wettlaufer-Lor	.06	West Dome	.14½

LONDON Feb. 5			
Alaska Tre'dwell	£7 2s 6d	Mexico Mines	£3 17s 6d
Burma Corp	1 13 9	Nechi, pfd	0 14 0
Cam & Motor	0 12 6	Oroville	0 14 6
Camp Bird	0 7 6	Santa Gert'dis	0 10 0
El Oro	0 8 9	Tomboy	1 2 0
Esperanza	0 10 3	Tough Oakes	0 12 6

N. Y. EXCH. Feb. 21		BOSTON EXCH Feb. 21	
Name of Comp.	Clg.	Name of Comp.	Clg.
Alaska Gold M	22½	Adventure	2½
Alaska Juneau	9½	Ahmeek	402½
Am.Sm.&Ref.,com	102½	Algomah	1
Am. Sm. & Ref., pf.	112½	Allouez	73
Am. Sm. Sec., pf. A	93½	Ariz. Com., ctfs	9½
Am. Sm. Sec., pf. B	86½	Bonanza	.35
Am. Zinc	82½	Butte Alex. Scott	‡9½
Anaconda	89¾	Butte-Ballaklava	4½
Batopilas Min	2½	Calumet & Ariz	74½
Bethlehem Steel	480	Calumet & Hecla	580
Bethlehem Steel, pf.	130	Centennial	16½
Butte & Superior	93½	Copper Range	66¾
Chile Cop	23½	Daly West	2½
Chino	59½	East Butte	13¾
Colo. Fuel & Iron	44¾	Franklin	9¾
Crucible Steel	78¾	Granby	96½
Dome Mines	24¾	Hancock	16½
Federal M. & S.	27	Hedley	25½
Federal M. & S., pf.	54¾	Helvetia	.40
Great Nor., ore., ctf.	44½	Indiana	5½
Greene Cananea	48½	Island Cr'k, com	46
Guggen. Exp	21½	Island Cr'k, pfd	89½
Homestake	130	Isle Royale	29½
Inspiration Con	46½	Keweenaw	2½
International Nickel	48½	Lake	17½
Lackawanna Steel	76½	La Salle	4½
Miami Copper	37	Mason Valley	2½
Nat'l Lead, com	68½	Mass	13½
National Lead, pf.	110	Mayflower	3½
Nev. Consol.	16¾	Michigan	2½
Ontario Min	7½	Mohawk	94
Quicksilver	5½	New Arcadian	9
Quicksilver, pf	7	New Idria	19
Ray Con	25¾	North Butte	28½
Republic I&S, com	52½	North Lake	1½
Republic I&S, pf	111	Ojibway	1½
Sloss-Sheffield	57	Old Colony	3½
Sloss-Sheffield, pf	96	Old Dominion	70½
Tennessee Copper	58½	Osceola	94
Utah Copper	85½	Quincy	97
U. S. Steel, com	83½	St. Mary's M. L	71½
U. S. Steel, pf.	116½	Santa Fe	3¾
Va. Iron C. & C	50	Shannon	11
		Shattuck-Ariz	38½
N. Y. CURB Feb. 21		So. Lake	6¾
Alta Con	‡.22½	So. Utah	.38
Beaver Con	.37	Superior	19½
Big Four	‡.04	Superior & Bost	3½
Buffalo Mines	‡1	Tamarack	52
Butte & N. Y	3½	Trinity	9½
Butte C. & Z	8½	Tuolumne	.17
Can. Cop. Corpn	1¼	U. S. Smelting	63½
Cashboy	.04	U. S. Smelt'g, pf.	50½
Cerro de Pasco	39½	Utah Apex	4 1/16
Con. Ariz. Sm	1 5/16	Utah Con	14½
Con. Coppermines	2	Victoria	4½
Con. Nev.-Utah	⅛	Winona	4½
Dia. Black B	.02	Wolverine	66¾
First Nat. Cop	6½	Wyandot	2½
Florence	.49		
Goldfield Con	.94	BOSTON CURB Feb. 21	
Goldfield Merger	.17	Bingham Mines	8
Hecla Min	4½	Boston Ely	.45
Howe Sound	5½	Butte & Lon'n Dev	.70
Kennecott Cop	56	Calaveras	3½
Kerr Lake	4½	Calumet-Corbin	.05
Magma	18	Chief Con	1¾
Majestic	1½	Cortez	.65
McKinley-Dar-Sa	.45	Crown Reserve	.40
Mines of Am	2½	Davis-Daly	1¾
Mother Lode	.21½	Eagle & Blue Bell	1 1/16
Nevada Hills	.20	Houghton Copper	2½
New Utah Bingham	4½	Iron Cap Cop., pf	7
Nipissing Mines	6¾	Mexican Metals	.40
Oro	.04½	Mojave Tungsten	5½
Ray Hercules	3¾	Nat. Zinc & Lead	2½
Rochester Mines	.61	Nevada-Douglas	.94
St. Joseph Lead	15½	New Baltic	3½
Stand'd Oil of N.J.	507	New Cornelia	11½
Standard S. L	1¾	Ohio Copper	.20
Stewart	1/16	Oneco	.80
Success	.95	Raven Copper	.18
Tonopah	7	Rex Cons	.17
Tonopah Ex	4 1/16	Rilla	1 1/16
Tonopah Merger	.60	United Verde Ext	13
Tribullion	⅛	Utah Metal	9
White Knob, pf	2		
Yukon Gold	2½	‡Last Quotations.	

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1914	1915	1916	1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.953
February	57.506	48.477	.....	26.573	22.753	.....
March	58.067	50.241	.....	26.788	23.708	.....
April	58.519	50.250	.....	26.958	23.709	.....
May	58.175	49.915	.....	26.704	23.570	.....
June	56.471	49.034	.....	25.948	23.267	.....
July	54.678	47.519	.....	25.219	22.597	.....
August	54.344	47.163	.....	25.979	22.780	.....
September	53.290	48.680	.....	24.260	23.591	.....
October	50.654	49.385	.....	23.199	23.925	.....
November	49.082	51.714	.....	22.703	25.094	.....
December	49.375	54.971	.....	22.900	26.373	.....
Year	54.811	49.604	.....	27.314	23.675	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York Electrolytic		London Standard		London Electrolytic	
	1915	1916	1915	1916	1915	1916
January	13.641	24.008	60.756	88.083	65.719	116.17
February	14.394	.....	63.494	.....	*	.....
March	14.787	.....	66.152	.....	*	.....
April	16.811	.....	75.096	.....	*	.....
May	18.506	.....	77.600	.....	*	.....
June	19.477	.....	82.574	.....	95.333	.....
July	18.796	.....	76.011	.....	91.409	.....
August	16.941	.....	68.673	.....	82.333	.....
September	17.592	.....	68.915	.....	85.250	.....
October	17.686	.....	72.601	.....	88.000	.....
November	18.627	.....	77.744	.....	93.273	.....
December	20.133	.....	80.773	.....	100.43	.....
Year	17.275	.....	72.532	.....	.....	.....

TIN

Month	New York		London	
	1915	1916	1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	.....	176.925	.....
March	48.426	.....	180.141	.....
April	47.884	.....	166.225	.....
May	38.790	.....	162.675	.....
June	40.288	.....	167.636	.....
July	37.423	.....	167.080	.....
August	34.389	.....	151.440	.....
September	33.125	.....	152.625	.....
October	33.080	.....	151.554	.....
November	39.224	.....	167.670	.....
December	38.779	.....	167.000	.....
Av. year	38.500	.....	163.960	.....

LEAD

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	.....	3.718	.....	19.122	.....
March	4.053	.....	3.997	.....	21.883	.....
April	4.221	.....	4.142	.....	21.094	.....
May	4.274	.....	4.182	.....	20.347	.....
June	5.932	.....	5.836	.....	25.170	.....
July	5.659	.....	5.531	.....	24.611	.....
August	4.656	.....	4.520	.....	21.946	.....
September	4.610	.....	4.490	.....	23.151	.....
October	4.600	.....	4.499	.....	23.994	.....
November	5.155	.....	5.078	.....	26.278	.....
December	5.355	.....	5.266	.....	28.807	.....
Year	4.628	.....	4.587	.....	22.917	.....

SPELTER

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan	6.386	16.915	6.211	16.745	30.844	89.810
Feb	8.436	.....	8.255	.....	39.819	.....
Mar	8.541	.....	8.360	.....	44.141	.....
April	10.012	.....	9.837	.....	49.888	.....
May	14.781	.....	14.610	.....	68.100	.....
June	21.208	.....	21.038	.....	100.614	.....
July	19.026	.....	18.856	.....	97.250	.....
Aug	12.781	.....	12.611	.....	67.786	.....
Sept	13.440	.....	13.270	.....	67.841	.....
Oct	12.800	.....	12.596	.....	66.536	.....
Nov	15.962	.....	15.792	.....	88.409	.....
Dec	15.391	.....	15.221	.....	89.400	.....
Year	13.230	.....	13.054	.....	67.553	.....

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	.....	13.45	.....	13.90	.....
March	14.55	.....	13.45	.....	13.95	.....
April	14.55	.....	13.45	.....	13.95	.....
May	14.64	.....	13.60	.....	13.83	.....
June	14.70	.....	13.67	.....	13.77	.....
July	14.94	.....	13.91	.....	13.68	.....
August	16.01	.....	15.31	.....	14.75	.....
September	16.86	.....	15.95	.....	15.70	.....
October	16.95	.....	15.96	.....	15.80	.....
November	18.26	.....	17.30	.....	17.20	.....
December	19.95	.....	18.95	.....	18.95	.....
Year	$14.89	.....	$13.76	.....	$13.89	.....